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SELECT COMMITTEE ON NATIONAL WATER RESOURCES

HEARINGS 1959 - 60

WATER RESOURCES

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WATER RESOURCES

THE UNIVERSITY
OF MICHIGAN

FEB 25 1960

MAIN
READING ROOM

HEARINGS

BEFORE THE

SELECT COMMITTEE ON NATIONAL WATER RESOURCES UNITED STATES SENATE

EIGHTY-SIXTH CONGRESS

FIRST SESSION

PURSUANT TO

S. Res. 48

DETROIT, MICH., OCTOBER 29, 1959

PART 7

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(Pursuant to S. Res. 48, 86th Cong.)

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WATER RESOURCES

THURSDAY, OCTOBER 29, 1959

U.S. SENATE,
SELECT COMMITTEE ON NATIONAL WATER RESOURCES,
Detroit, Mich.

The select committee met at 9 a.m., pursuant to Senate Resolution 48, in room F, McGregor Memorial, Detroit, Mich., Senator Robert S. Kerr (chairman) presiding.

Present: Senators Kerr and Hart.

Also present: Representative O'Hara.

Also present: Theodore M. Schad, staff director of the select committee, and Paul McBride, chief clerk.

The CHAIRMAN. I am very happy to be here this morning in the great State of Michigan with my good friend Senator Phil Hart and to have the opportunity to hear some of the testimony to be given with reference to the available supplies of water in the State of Michigan, the amount of beneficial and consumptive use, the requirements for the two decades ahead, and the forecast for requirements beyond that.

This is the 7th State in which we have held hearings, and it is the 10th of the hearings that we are to hold. We expect to go into approximately 25 States for about 30 to 35 hearings and then have an extended opportunity in Washington to hear those who want to be heard and in whose areas we have not been able to visit.

We find that whether we go to a highly industrialized area, such as California, or a semiarid area such as South and North Dakota, each State, each area, has problems peculiar unto itself, yet whose future is dependent upon the solution of its own problems.

The sum total of those problems is what we seek to learn, because when digested, analyzed, and understood they will provide the opportunity for the real progress we expect and hope to come from the hearings, which will culminate in the deliberations and recommendations of this committee.

This committee is composed of members of the Senate Interior and Insular Affairs Committee, the Interstate and Foreign Commerce Committee, the Committee on Agriculture and Forestry, and the Public Works Committee.

Your very able senior Senator, Pat McNamara, is a member of our Public Works Committee.

Again I want to tell you how glad I am to be here with Phil Hart, whom I regard as one of the finest men I have met in the Senate and in the State which I feel is so fortunate not only to have the great natural resources that it does, but the great human resources in the identity of its two Senators.

Senator Hart will make such statement as he desires and call upon such witnesses as he wishes to have heard.

Senator Hart.

STATEMENT OF HON. PHILIP A. HART, U.S. SENATOR FROM THE STATE OF MICHIGAN

Senator HART. Thank you, Mr. Chairman.

I hope the hearing today will give a fair treatment to the overall concern of the Great Lakes Basin. I know we are a Nation which has grown too big to be regional but we are a Nation made up of regions. If today's hearings can give all of us a feel as to the regional pressures with respect to water in the years ahead it will enable us, I think, as a committee to make a more effective presentation of the national picture. In addition to spokesmen from the State of Michigan, Mr. Chairman, we will hear this morning from the State of Ohio, State of Wisconsin, State of Indiana, and several governmental units in all of those States.

I will save the time of all of us and put it to better profit by concluding my statement by thanking you very much for enabling the committee to come into the Great Lakes region.

I would add a footnote that Senator McNamara today is conducting a hearing in California of a Senate subcommittee of which he is the chairman and has sent by telegram his best wishes to this committee in the hope that we have a successful hearing here.

I know that the explanation of the Governor's absence will be made by the attorney general, but all of us regret the circumstances which make it impossible for the Governor to testify; he had intended to be here.

The CHAIRMAN. At this point in the record, we will incorporate the telegrams from Senator McNamara and Governor Williams.

(The telegrams referred to follow:)

LANSING, MICH., *October 28, 1959.*

HON. ROBERT S. KERR,
U.S. Senator,
Care of Sheraton Cadillac Hotel:

Welcome to Michigan. I sincerely regret a previous commitment in Grand Rapids will prevent me from attending reception in your honor. I am happy, however, that our Lieutenant Governor, John Swainson, will represent me and extend my personal greetings and best wishes to you.

G. MENNEN WILLIAMS, *Governor.*

DETROIT, MICH.

HON. PHILIP A. HART,
U.S. Senator,
Senate Office Building.

DEAR PHIL: Thank you for invitation to join water resources hearing October 29; sorry I cannot be present. Shall be out West on Senate business. My very best wishes for a successful hearing.

Sincerely,

PAT MCNAMARA, *U.S. Senator.*

Senator HART. We will do our best to hear everyone. If there are any here who would like to make a statement for the record, but who are not, as far as they know, presently listed, please speak to Mr. Welsh, who will raise his hand and thus identify himself, and we will

make every effort to hear you. In any event we will make sure that the record contains the statement.

Mr. Chairman, I will call, first, the attorney general of Michigan, the Honorable Paul Adams.

I know that the chairman is familiar with the attorney general because——

The CHAIRMAN. Let us say acquainted with.

Senator HART. Acquainted with—the acquaintanceship stems from a certain matter involving the city of Chicago and the lakes adjacent to us.

STATEMENT OF HON. PAUL ADAMS, ATTORNEY GENERAL, STATE OF MICHIGAN

Mr. ADAMS. Senator Hart, Senator Kerr: On behalf of the State of Michigan I wish to welcome both of you and tell you how happy we are to have you here in Michigan.

I regret that Governor Williams is unable to be here this morning because he was detained in Lansing by conferences with leaders of the State legislature. He has asked me to convey his personal welcome as well as his regrets that he is unable to be with you.

The CHAIRMAN. We had a nice telegram from your Governor and, it has been placed in the record.

Mr. ADAMS. Very good, Senator Kerr, and he will be filing a written statement later with the committee with your permission.

I might say that despite the publicity given to recent events, the State of Michigan does have tremendous resources, both human and material, and makes a prominent and valuable contribution to the economy of our whole country as well as of the world. During World War II, as we all know, the State was known as the heart of the war effort, and this is one of the reasons why we are very happy to be here with you this morning and discuss our water resources.

The CHAIRMAN. We in Oklahoma think your State is one of the very great States in our peacetime economy. We feel there is a peculiar affinity between Oklahoma and Michigan. Our oil would not be worth nearly as much were it not for your automobiles.

I am also persuaded that maybe your automobiles would not be nearly so useful if it were not for our oil.

So there is an interdependence that we cherish and the basis, we hope, for even greater friendship in the future.

Mr. ADAMS. We hope that the means of consumption of our oil will continue to expand in the future, Senator Kerr.

I am told that Pindar, the early Greek lyric poet, is purported to have said that "the best of all things is water." Water has certainly played a decisive role in the rise and fall of civilizations, and we realize that in the world today the presence of water in any particular area, determines the status of the life and civilization in that area. The struggle for the use of water is both an ancient and a modern one, and I think I could best sum up the position of Michigan in this matter by the words of C. J. Hoffmaster, for many years the director of our department of conservation, when he said "Michigan's wealth is in her waters."

We are here to discuss with you many of the problems arising out of the utilization of the water resources of our State. You will be given a great mass of information by the various State agencies, as well as universities which deal with some of the various aspects of water uses. It is not necessary that I repeat in any way what they are going to present to you, but I do want to say that many of the officials of these agencies are here. That some of them are going to present their material orally and some of theme are going to file it with you. All of them are here to answer any questions which the committee would like to put to them and assist the committee as it progresses with its work on this subject.

There are certain phases of water utilization which are not covered by the other State agencies and which I propose to present to you.

(1) First of all, Federal and State relationship in the management and control of water.

Many conflicts have arisen in various States of the Union between Federal and State government as to just what rights each had and what role each should play in this field. Some of these disagreements have grown into open conflict and have given rise to legal battles which have reached the Supreme Court of the United States. It is not my purpose this morning to elaborate on these conflicts, but rather to express to you what we believe should be the relationships which should prevail between the States and the Federal Government in this particular area of our country.

We all recognize, of course, that under our Constitution certain powers are delegated to the Federal Government which, when exercised, are paramount to the rights and powers of the States. We are all aware that during recent years the powers delegated to the Federal Government have been expended by implication to the point where many States have been embarrassed in the exercise of their sovereignty over their natural resources. We would like to avoid conflicts of this kind taking root between States of the Great Lakes region and the Federal Government.

It seems to me that if we adhere to the following principles our two governments should be able to make the fullest utilization of the water resources of our State as well as the other States in this area:

(*a*) The Federal Government should respect the sovereignty and rights which the States have over the natural resources which are within their respective borders. Each of our States depends on the natural resources lying within her borders for the building and expansion of her economy—which forms the base of providing for the health and welfare of her citizens, the education of her children, and the raising of taxes for the support of State and local services. The Supreme Court of the United States recognized in the case of *Georgia* v. *Tennessee Copper Company* (206 U.S. 230), that a State has a real interest, quasi-sovereign in character, in all the earth, water, and air within its domain. Thus, when Congress deals with these matters, it should bear in mind that each State has a responsibility to its citizens for the control, utilization, and management of these natural resources.

(*b*) Federal and State programs with respect to natural resources, and particularly water, should be cooperative in nature. Those phases of the program which can be best administered by the State should be left to the State, and the Federal Government should play only that

role and take only those responsibilities which the State by itself, or even in conjunction with other States, cannot do. This role is being played by the Federal Government in many instances and has proved out to be very satisfactory and helpful.

(*c*) Where the supervening national interest is involved or it is desirable that uniformity throughout the Nation be secured, the Federal Government should determine the minimum criteria which each State should live up to and give the States a fair opportunity to evolve a program which will meet the nationally set criteria. To the fullest extent compatible with the national interest, the rights of each State should be respected in the development and administration of these programs.

The foregoing will in effect allow us to make the fullest use of State power and State sovereignty but assure us that the exercise of such power and sovereignty be kept within the limits of an overriding national policy.

(2) The second point I wish to discuss is the interstate and international relationships.

Many of the States, and particularly the Great Lakes States, are the owners and sovereigns over large interstate as well as international bodies of water. I make special reference to the enormous Great Lakes Basin which includes, of course, the St. Lawrence River. The State of Michigan borders on four of the five Great Lakes and has one of the longest shorelines of any—3,200 miles, I might say. A great deal of its boundary is in common with that of Canada. At the present time we are engaged in a legal controversy with the State of Illinois over the diversion which has been made and which Illinois wants to augment at Chicago. During the past 2 weeks, testimony has been presented to the special master appointed by the Supreme Court. In due time this controversy will culminate in a decision of our Supreme Court.

Regardless of what that court does and even regardless of what our own State and the Federal Government do with this diversion controversy at Chicago, the fact remains that it cannot be finally settled without the participation of the Government of Canada. Whether this international problem should be allowed to remain in the domain of diplomatic negotiations, or whether it should be referred to the International Joint Commission, or whether there should be a special commission set up to handle it, is a matter which, of course, has to receive the proper attention of the Federal Government.

However, in doing so, it should not be lost sight of that the States of the Great Lakes have a vital interest in whatever disposition is made and should be allowed to express themselves whether to the State Department or to the international body created for that purpose before any final adjudication or agreement with Canada is consummated.

(3) The third point I would like to mention is the Great Lakes compact, because in this area I think the Great Lakes States are making great progress toward solving their mutual problems.

In 1955, Michigan took the leadership in the organization of a compact among the Great Lakes States. This compact agreement was worked upon by representatives of all of the Great Lake States

and ultimately adopted by the States of Minnesota, Wisconsin, Illinois, Indiana, Pennsylvania, and Michigan. Although Ohio and New York have not yet adhered to the compact, the States which belong to it have a functioning organization with offices in the Rackham Building at Ann Arbor, Mich. Already the Great Lakes Commission has been of tremendous and invaluable service to the Great Lakes region and Mr. Marvin Fast, director of the commission, is here to present to you a statement from that commission.

(6) I am happy to say that the Senate on two occasions has passed it, and it is now in the House, where we trust passage will take place before the session is over. It is important that this consent be given so that proper representation may be accorded the Federal Government within the framework of this compact organization. The compact among the Great Lakes States was organized for the purpose of making a continuing study and providing a permanent organization of the Great Lakes States with respect to all the problems arising out of the use of this tremendous natural resource.

I might say I think it is interesting, Senator Kerr. In spite of the disagreements which we have and probably will continue to have with the State of Illinois with regard to the diversion problem, we have been able to work with that State and the other States on many common problems as a result of this theory of the compact between the States.

(4) The Great Lakes fisheries are one of the most invaluable resources of the Great Lakes and they are the greatest of their kind in the world. Many attempts have been made in the past to bring about some kind of uniformity out of the regulations adopted by each State in the management of this great resource. Although these efforts found some success in recent years, the fact remains that there are great disparities in the regulations not only between the States but also between the States and the Provinces of Canada bordering these waters. For many years a treaty lay in the Senate for the purpose of establishing an international commission which would have been empowered to exercise regulatory authority over this fishery. This treaty, of course, was never ratified and was finally withdrawn by the President a few years ago and a new and more limited treaty was submitted and approved by the Senate. This new treaty provided for the establishment of an international commission to be vested only with authority to conduct research programs and particularly to concentrate its efforts on the eradication of the sea lamprey which has devastated the important species of fish of the Great Lakes such as the lake trout and whitefish. This commission has been hard at work, and they have achieved considerable in eradicating this pest.

Efforts should be exerted even at this time for the negotiation of a treaty with Canada for the wise utilization and management of the fishery resources of this tremendous water area. In recent years our Government has negotiated fishery treaties along the maritime coasts with other nations; otherwise improper and exhaustive fishing of these waters would have depleted them of certain species of fish. It would seem that this same policy should be extended to the Great Lakes area.

The treaty with Canada known as the Migratory Bird Treaty which Congress implemented by passage of the Migratory Bird Act is

an excellent example of how beneficial such a treaty could be. The Federal agency administering this act and the various State and Provincial conservation departments work very cooperatively in the management of migratory birds and waterfowl and as a result this invaluable wildlife resource is being preserved rather than destroyed.

(5) Finally, pollution control. The water resources commission will present you with a great deal of data on our State's program in water pollution control within the interior of our State. However, our State, as I have said before, has a common boundary with Canada extending for many miles. Much of this boundary is in the Detroit River, Lake St. Clair, the St. Clair River, and the St. Mary's River, where our shores are not too far apart. In recent years, we have had difficulties over pollution that was being introduced at various Canadian points both by municipalities and industries. After a study that began in the middle forties, the International Joint Commission under the Boundary Waters Treaty of 1909, set up minimum criteria of boundary water quality which have been accepted by both Governments. However, the Commission relies on the State governments to make these criteria effective. I merely want to point out that as a result of our appearances before the International Joint Commission, various pollution problems between Michigan and Canada have been and are being resolved. The most recent one arose out of our fear that oil drilling operations in Lake St. Clair and in Lake Huron on the Canadian side of the boundary would result in the pollution of these waters, to the injury not only of American interests but even of Canadian interests as well. This matter was presented to the International Joint Commission and efforts are now being made to bring about either a cessation of these operations or placing them under such strict regulation that the danger of pollution of our water will be minimized. In these instances we need the continuing support and backing of our Federal Government, our State government and other Federal agencies, and all phases of our governmental operations in this country and in Canada.

In conclusion, I certainly think that the Senate is to be congratulated on conducting these hearings around the country.

I understand, Senator Kerr, that you have been provided with a little booklet entitled "What Is Ahead for Michigan?"

The CHAIRMAN. That is right.

Mr. ADAMS. I would particularly like to direct your attention to pages 34 and 35 of this booklet because I think it sums up far better than anything I might say of the picture and the problem.

It is stated here that the President's Materials Policy Commission has said that water supply has always had a significant effect on industrial location but until recently most of this influence was exerted in an indirect manner. By 1975 water supply may be the most important factor affecting industrial location.

Mr. Haber and his colleagues then go on to point out other quotations, that in the year 1957 which is already behind us, one in every four Americans felt the water shortage is some manner, and that in the year 1970 large parts of Ohio, Indiana, and Kentucky, our immediate neighbors, may be facing serious problems.

We here in Michigan feel that we have a wonderful and a tremendous resource in the waters that surround our State, and we do appre-

ciate the interest that is shown in many problems that will be presented to your committee here today.

Thank you very much.

Senator HART. Thank you, Mr. Adams.

I am sure Senator Kerr was struck as I was with the following. We have just come from South Dakota where the concern is limited. There is an awareness of the obligation of downstream interests, but so often the emphasis is on "what is under my feet and how far do I have to go down to get it and why isn't it coming up clearer than it is?"

I think that we have already sensed the note of difference which results because we have been blessed here with water in such apparent abundance that we have almost ancilliary concern, in contrast with the region which is water-short right now.

Sir, have you any questions?

The CHAIRMAN. No questions.

Senator HART. Thank you.

The next witness is the longtime director of our water resources in Michigan, Milton P. Adams.

For those who may not be directly concerned, but are curious about the schedule, or have some suggestion they might prefer to make in less formal fashion than from the stand, I would like, with the chairman's permission, to introduce the staff director of this Senate select committee, and ask him to stand. Those of you who have any such comment or inquiry could very properly direct it to Ted Schad, the staff director. He is on loan from the Library of Congress and has a background with the Bureau of the Budget, the Bureau of Reclamation and the Corps of Engineers. Ted Schad.

Mr. SCHAD. Thank you.

Senator HART. Milt.

STATEMENT OF MILTON P. ADAMS, DIRECTOR, MICHIGAN WATER RESOURCES COMMISSION

Mr. ADAMS. Mr. Chairman and Senator Hart.

You do us honor to be with us today and take stock and inventory of our water resources. I am aware of the need for the saving of time. I do not want to throw anyone into a tailspin when they look at this large and formidable document.

I think I should tell you my prepared statement, however, takes some 14 pages. I would like to ask that that be made a part of the record and then I will speak informally.

(The statement referred to follows:)

STATEMENT BY MILTON P. ADAMS, EXECUTIVE SECRETARY, MICHIGAN WATER RESOURCES COMMISSION

Michigan's claim to the title "Water Wonderland" is based among other things on the following resources:

1. The variable seasonal flows of its 36,350 miles of rivers and streams.

2. The waters of its 11,037 inland lakes.

3. The State's portions of the Great Lakes. This comprises some 39,000 square miles of water in Lakes Superior, Michigan, Huron, St. Clair, Erie, and their connecting rivers. Developed and undeveloped bordering shoreline on these waters amounts to some 3,251 miles.

4. Ground water reservoirs, of variable quantity, quality, and availability. These underlie much of the 57,000 square miles of emergent land area of the State.

These resources are maintained by the State's average annual precipitation of 31.7 inches.

Activities and State assets with which we are most familiar that are derived from the State's bank of water resources may be listed as follows:

1. *Recreation.*—Our annual $650 million tourist and resort industry can be served and expanded almost without limit on the present resource base so long as appropriate natural water qualities are maintained.

2. *Power.*—Most of Michigan's electric power is now generated in steam plants where water is the indispensable cooling and condensing medium. Newest locations are on the "big" waters of the Great Lakes. Here not only ample water of high quality and low temperature is available, but low-cost water transportation for fuel is afforded as well.

3. *Municipal and industrial supplies.*—Something over 2 billion gallons per day are needed in the State to handle needs of municipalities and industry. About 75 percent of the State's population is dependent on surface water as its source of supply.

4. *Agriculture.*—Only about seven-tenths of 1 percent of the actively farmed cropland of the State are irrigated. Yet this practice appears to have increased fivefold in the 10-year period 1947–56. Presently there are nearly 70,000 acres under irrigation.

5. *Sewage and waste effluent assimilation.*—Needless to say, most municipal and industrial water supplies after use in homes or factories are returned after treatment to surface waters of the State. Ever expanding industries and population are creating new sources of waste. This must be cared for by appropriate treatment or disposal methods; otherwise municipal, recreation, water supply, even agricultural interests are to suffer.

Some of the problems growing out of the presence and use of Michigan's water resources may be listed as follows:

1. The need of $100 million per year expansion of municipal water and sewage facilities.
2. Flood control.
3. Stream flow stabilization.
4. Beach erosion control.
5. Great Lakes levels control.
6. Pollution control.
7. Water rights.
8. Collection of basic data.

In response to earlier requests, we have submitted to you as chairman of the select committee and to Senator Hart copies of a summary outline. This covered and listed the major water resources problems of Michigan that seemed to us at the time to come within the possible scope of interest of your committee. Under the plan of coordination of State agency interests worked out by Governor Williams' staff, there will be certain problems of interest to the water resources commission which may be reported upon by representatives of other State agencies. Conversely, it may be expected that some of the matters on which I may report will be of interest to and will affect the interests of other State departments. It is my assignment as executive secretary of the water resources commission to develop and discuss the eight problem areas just listed.

MUNICIPAL WATER AND SEWAGE NEEDS

At Kellogg Center on the campus of Michigan State University, in November 1955, the water resources commission announced in a report given at the Governor's conference on "Michigan's Water, Sewer, and Drainage Needs" that the municipalities in the State must spend close to $1 billion in the next 10 years to provide their needed water and sewer facilities. This estimate was based on the returns from a questionnaire submitted to 352 local governmental units. From the 260 replies received, the above weighted estimate was prepared to include the total urban population of Michigan. It should be noted that no attempt was made to estimate industrial needs except as they are served by existing municipal systems.

From reports submitted to this office from the U.S. Department of Health, Education, and Welfare on "Sewage and Waterworks Construction" for 1957 and 1958, we note that Michigan's municipalities awarded contracts for $105

million, an average of about $52.5 million per year. Yet based on estimates furnished us in 1955, Michigan cities and villages should have been spending $100 million per year between 1955–65 to satisfy these requirements. From these data we can only conclude that the municipal governmental units in our State are falling behind in meeting their needs for water and sewage facilities.

The above report and estimates make no provision for a subsequently developed plan for bringing Lake Huron water to the Flint area—some $75 million, nor does our 10-year survey of 1955 make any provision for subsequently considered plans for bringing Lake Huron water down to the Detroit metropolitan area. The cost of this latter would vary with the project scope and area to be served. Estimates are not currently available to us.

FLOOD CONTROL

The physical situation that gives rise to floods and determines their frequencies and magnitudes is the same in Michigan as elsewhere in the Nation. The fact that most of our rivers are relatively short and do not bring us problems of out-of-State origin, is a distinguishing characteristic. In all other respects, we are as much at the mercy of the elements as those parts of the country wherein recent combinations of natural phenomena have brought serious floods into actuality.

Michigan is even more vulnerable to flood damages than many other regions because of the intensive industrial and municipal development that has taken place within its flood-potential areas. Such encroachment into zones wherein intensive development might be condemned as being based on lack of perfect foresight is not, of course, peculiar to this State but is associated with human enterprise and human failings everywhere. Furthermore, our having been spared by the laws of chance during recent times has contributed very heavily to a popular feeling of security, despite all admonitions from hydrologic professionaldom that continuation of our good fortune cannot be expected to last indefinitely.

Fragmentary records available reveal the occurrence of several floods in Michigan early in the century the repetition of which today, under modern conditions of land usage, would wreak almost unimaginable destruction in our interior metropolitan areas and their surrounding residential developments. We are, in short, living on borrowed time and the warning in records of the past that it "can happen here" are relegated in the mind of the man on the street to those mental pigeonholes that he reserves for all the catastrophes that could happen but so far haven't.

Under the Federal flood control laws, surveys by the Corps of Engineers have been initiated in many localities and brought to the stage of congressional authorization for a few. Only one project, that of the Kalamazoo River at Battle Creek, involving some $3 million of Federal money, is under construction. However, nearly all of our interior towns and cities in the southern half of lower Michigan are located upon streams which can and will flood heavily. Among them are municipalities situated along the banks of the Grand, Saginaw, Flint, Shiawassee, Cass, Tittabawassee, Clinton, Huron, Rouge, Raisin, St. Joseph, Kalamazoo, Black, and their tributaries. They include nearly all of our larger interior cities such as Flint, Midland, Saginaw, Lansing, Battle Creek, Kalamazoo, Grand Rapids, their small satellite towns, and much of their widely sprawled suburban residential areas.

Whether alleviation of this exceedingly grave problem is needed by your committee's target date of 1980 or by 1970 or by 1965 relates not to prognostications of future developments but to the utterly unpredictable occurrence—not of record floods but even of those such as we have already experienced in early times. The need is actually upon us today.

Heeding the warning sounded by our most recent but relatively minor floods of the late forties, farsighted officials of some few Michigan communities have sought and obtained Federal cooperation in the advancement of Federal flood control projects to the point where congressional appropriation of funds is needed. These projects, totaling some $35 million in Federal participation, would provide protection to Lansing, Kalamazoo, Midland, Flint, portions of their immediate environs, and some of the smaller towns. Favorable congressional action upon these needs at an early date is earnestly recommended.

Far beyond these modest needs thus far identified in project terms, however, is the overriding and inescapable need for an entirely new Federal approach to

the whole matter of flood problem anticipation and avoidance. It is not enough, we submit, for the Federal Government to take cognizance of only those situations where the actual occurence of catastrophe has brought home to local residents the fact that their homes, businesses and fortunes are in danger. This, we suggest, is very much in the nature of locking the barn door after the horse is stolen.

A realistic Federal policy in flood control, that recognizes the national integrity and the importance of the security of the parts to the security of the whole, would identify specific problems without waiting for each individual community to discover for itself, through grievous experience, what those problems are. A nationwide survey by appropriate State, Federal, and local agencies should be undertaken without further delay to appraise the flood potential at all localities and to clearly set forth the corrective measures that are indicated by its findings. All levels of government should participate in a cooperative program to (1) establish and enforce measures to control future development of flood hazard areas, in the best interests of the local communities and the Nation, and (2) develop flood control works established equities indicate their economic and social necessity.

STREAMFLOW STABILIZATION

The usefulness of water resources for the many purposes they must serve is dictated and delimited very largely by their stability. Flood flows, which account for an appreciable portion of total annual flow in most streams, are generally recognized as being virtually useless. This wastage in the face of ever mounting water demands of all kinds is a first order challenge to be met if water conservation benefits are to be attained. For example, the average annual flow of the Grand River at Lansing is 860 cubic feet per second. However, its summer flows, the "bottleneck" for waste assimilation and steam-turbine cooling, quite frequently decline to 100 cubic feet per second or less for weeks at a time.

The Tittabawassee at Midland averages 1,400-plus cubic feet per second but the dependable flow, to which this nationally vital chemical center must gear most of its river water uses is less than 300 cubic feet per second.

Other rivers in Michigan and throughout much of the Nation are similarly characterized by wide disparities between their theoretical potential and their actual present usefulness.

The need for imposing artificial controls and regulations upon the natural regimen of rivers for purposes of flood control, navigation, irrigation, power development, and recreation has long been widely recognized and the propriety of Federal participation in the development of such benefits is firmly established in the American concept of water resources management.

We suggest that developing the enormous resource potential that is now being wasted in erratic riverflows offers another great field of opportunity for benefit to the Nation's economy. This can only be achieved through cooperative intergovernmental programs in which the Federal agencies must necessarily assume an important role. Physically, the stabilization of riverflows at higher minimum rates involvés the construction of reservoir networks to store seasonal excesses of runoff for controlled release as needed. Practically, however, such programs may be highly complex because of the many and varied and sometimes conflicting interests that are affected. A challenge is thus laid down to all levels of government and to all water interests to cooperate in the analysis, planning, development financing, and administration of realistic improvement measures along this last frontier of water resource conservation.

Alternatives to the reservoir scheme for streamflow stabilization do not exist. This surplusage of water under consideration is all we have to work with and use. This by no means depreciates the benefits to be expected from continued expansion of the great soil conservation movement, the effects of which upon water can only be salutary, particularly with respect to quality. Neither does it ignore the relatively limited but in some cases highly significant potential for improved ground water management through artificial recharge programs. The benefits from such programs, however, will accrue primarily to underground supplies and only incidentally and on a minor scale nationally to streamflow stabilization. In the final analysis, only dams and reservoirs can counteract the hydrological eccentricities of nature on the scale requisite to the national welfare.

The "network" aspects of reservoir programs should be emphasized, for the benefits from any storage site accrue in a downstream direction only. Ideally, all reservoirs should be located in headwaters areas in order that the whole

river system may be served. The scarcity of sites physically suitable for effective reservoir use, however, will necessitate the development of middle and downstream locations as well.

Considerable urgency attends this water resource conservation need, not only with respect to the fulfillment of present and prospective water use demands but, more importantly, with respect to the preservation of these vital reservoir areas for development as needed. Only so many usable sites exist and their numbers are fast diminishing as they are intensively developed for other purposes.

A cooperative State-Federal program should be initiated to (1) complete as rapidly as possible a nationwide inventory of available reservoir sites, (2) acquire, or in some equitable manner reserve from other permanent development, the sites necessary for long-range objectives, and (3) construct and operate dams as the need appears

Hand in hand with reservoir development must come completion of the fullest possible erosion control on upstream lands. Unless this basic need is recognized and met, reservoir siltation can seriously compromise and ultimately destroy the effectiveness of the entire program.

BEACH EROSION CONTROL

With more than 5,000 miles of length along seven States, the Great Lakes shoreline is an obviously great national asset. Most of this interior seacoast is highly adaptable to intensive recreational and resort use, to the great benefit of summer vacationers of the entire Nation.

Unlike the coast along the ocean proper, the Great Lakes beaches are subject to sporadic and sometimes protracted rises in water level which, under conditions of storm, cause exceedingly great damage to beaches and waterfront structures. As with floods the direct recipients of injury are chiefly private, partly public. However, Federal participation in beach erosion control is limited by statute to not more than 50 percent of survey costs, 30 percent of construction costs, and even then the projects must be aimed primarily at protection of publicly owned frontage. No such limitation applies to flood control.

Over and above the question of consistency in Federal policy as between beach erosion the river flood control projects is the Federal interest in protection of a great national resource. Not only Michiganites take pleasure and benefit from the 3,200-plus miles of this State's beaches but residents of the entire country. It is notable too that Federal navigation structures such as piers and breakwaters actually intensify erosion at many locations.

A realistic Federal policy would demand greatly increased participation in the preservation of this irreplaceable heritage from impairment or destruction by erosion.

GREAT LAKES LEVELS CONTROL

Relating to the erosion problem above cited, as well as to damages sustained by frontage, navigation, and other interests from extremes of low levels, the U.S. Corps of Army Engineers has initiated engineering studies of possible artificial control of Great Lakes levels. The scheduled completion date for these studies as originally authorized in 1952 has been postponed. It is now set for 1960. Resumption of excess runoff supply to the Great Lakes may come quickly and without warning at any time, as it has done in the past. (Lakes Michigan-Huron rose 5 feet in a little more than 3 years, from February 1926 to July 1929, and 4½ feet in the 2½ years from December 1949 to July 1952.) In the absence of preparatory engineering measures, excess supply will result in water pileup on the lakes. The above-cited rises were of very brief duration but, even so, the latest was attended by some $60 million damage to shore properties from the spring of 1951 to the spring of 1952. And the record shows that high levels may endure for many years. One such period lasted 30 years, in which the Lakes Michigan-Huron levels at least equaled and in many years greatly exceeded those of the 1951–52 period.

It should be noted that existing usage of the shores of Lakes Michigan-Huron and their beaches as we know them, have developed under conditions of low water levels that have persisted almost without interruption for the past 40 years.

The return of even normal lake levels can be expected to set off sequences of geological readjustments in the beach zone that will be highly incompatible with present patterns of beach usage. Abnormally high levels, if continued for any length of time, offer an ominous prospect of damage and destruction to beach properties and structures that have been built upon them.

Careful attention should be accorded to next year's report of the corps on lake level control, upon its release, and any possibilities the report may disclose for alleviation of fluctuation extremes should be acted upon expeditiously.

Even with the best artificial controls, however, the need for judicious planning of beach area developments cannot be avoided.

Following the high water of 1951–52, State laws were enacted granting local units of government the power to control use of lands subject to erosion innundation by Great Lakes waters. No action under these laws has yet been taken, to our knowledge.

Unless local government accepts the responsibility for regulating shore development to minimize damage from future high levels it can hardly complain if higher government takes over.

WATER POLLUTION CONTROL

A. Navigational

Increased navigation resulting from the seaway development and from the rapidly growing public interest in pleasure craft is bringing on a problem of pollution originating in navigation sources.

The following needs are indicated by analysis and interpretation of the statements presented at a conference which the International Joint Commission held with Great Lakes steamship operators on February 20, 1958, with reference to pollution of boundary waters as related to shipping operations on the Great Lakes and connecting waters.

(1) Determination of the existing authority exercised by various Federal agencies and of the States and Province of Ontario over vessel waste disposal and enunciation of policy by each of the agencies in administration of their respective authorities.

(2) Uniformity between the two countries in promulgating regulations for the proper disposal of wastes, particularly in view of the expected increase in traffic by vessels of foreign registry resulting from completion of the St. Lawrence Seaway.

(3) Development of effective mechanisms for policing and patrolling to assure that control measures are observed.

(4) Determination of specific role to be assumed by each agency of government at the Federal, State, and provincial level in securing compliance with Commission objectives.

(5) Determination of appropriate agency to exercise control over waste disposal from pleasure craft.

There is also need for development of controls or supervision at the Federal level to prevent recurrence of such navigation accidents as the sinking of an oil barge in southern Lake Michigan in late November 1958. This resulted in fouling of approximately 150 miles of Michigan's recreational beaches during the summer of 1959 and consequent loss. As the situation now exists, there is nothing to keep an inexperienced master and crew from embarking on a voyage under dangerous conditions or with improper equipment and no way of obtaining any recourse from the results of their acts or exacting any penalty for their negligence or incompetence.

B. Land-based problems

Except as international or interstate problems are not resolved by action of the State originating such problems, we believe that pollution control is primarily a responsibility of the States. Federal grants to municipalities under Public Law 660, of 1956, have contributed importantly to the abatement of sewage pollution from public corporations. If this plan is to accomplish the desired objective in our State, the annual Federal contribution should be at least doubled as provided for in H.R. 3610 of the 86th Congress. Research leading to new or more efficient methods of sewage and waste treatment are long overdue. Such work can be best planned, supervised and coordinated by the Public Health Service as soon as Federal funds can be made available. Not less than a 10-year program ranging from $1 to $3 million per year would seem to be justified.

WATER RIGHTS

Although the problem of developing and administering water rights law suitable to resource and use conditions of the East and Midwest will be difficult, it is believed that this is essentially a State responsibility. Congressional action

to affirm the States' dominance in this field is supported as opposed to principles advanced by the Department of Justice and enunciated in the *Pelton Dam*, *Hawthorne*, and other cases.

BASIC WATER RESOURCE DATA COLLECTION

No water development and use projects can proceed soundly except as adequate information is available on the quantity and quality of the waters involved. Very little of such indispensable information can be obtained on a "one-shot" survey basis. On the contrary it must be collected over a period of years in order to reliably appraise the frequency and magnitude of variations in the subject water resource.

We strongly support continuation and expansion of the present U.S. Geological Survey State-Federal cooperative factfinding programs in stream and lake gaging and ground water resource investigations. We also recommend substantial increase in the U.S. Weather Bureau's data collection and research program, the Department of Agriculture's soil and water research activities, the U.S. Geological Survey's studies of basic hydrology, and the Public Health Service's water quality basic data program.

THE COMMISSION

Seven men make up the Michigan Water Resources Commission, which holds monthly meetings. Four are ex officio members being heads of major State departments. The three citizen members are appointed by the Governor and are subject to senate confirmation.

Current members and interests particularly represented are as follows:

A. E. Heustis, M.D., chairman, State health commissioner, public water supply and public health.

George F. Liddle, vice chairman, municipal groups, municipal water use and flood control.

Gerald E. Eddy, director of conservation, recreational water use and resource conservation.

John C. Mackie, State highway commissioner, flood control, highway drainage, bridge and culvert design, and erosion control.

George S. McIntyre, director of agriculture, drainage, flood and erosion control, and water use by agriculture and agricultural industry.

Lynn F. Baldwin, conservation groups, recreational water use and resource conservation.

Carl E. Shultz, industrial management groups, industrial water use and flood control.

STATUS OF WATER POLLUTION CONTROL, GREAT LAKES WATERS

MEMBER STATES

By R. N. Barr, M.D., secretary of the Water Pollution Control Commission of Minnesota by letter dated July 29, 1959:

"MINNESOTA

"The Lake Superior Basin includes the St. Louis River Basin which serves the western portion of the basin and a relatively narrow strip of land about 20 to 30 miles wide extending northeasterly along the north shore of Lake Superior to the Canadian border.

"The total area of the basin is 6,069 square miles, and the population, according to the 1950 census, is approximately 200,000.

"The upper portion of the St. Louis River Basin consists of a range of hills which includes the east end of the Mesabi Iron Range. Below these hills is a relatively high plain containing numerous lakes and swamps with large areas of cutover wasteland. The lower end of the basin between Cloquet and Fond du Lac drops approximately 580 feet to the level of Lake Superior. There are five power developments in this area.

"Other streams in the basin discharge directly into Lake Superior north of Duluth and are short and precipitous, rising in lakes in the upper portion of the basin. They are used extensively for recreational purposes, including sport fishing, swimming, and boating. Municipalities in this area are all located on the shore of Lake Superior and use the lake for domestic water supply. Navigation

is limited to Lake Superior. No critical pollution has been found in the streams of the basin except for low oxygen in the St. Louis River below Cloquet during periods of low streamflow which have caused substantial fish losses in the river below Fond du Lac.

"There are 25 municipalities in the basin with sewer systems; treatment plants are provided or under construction in 24 of these communities. One plant was completed in 1958, and two plants are scheduled for completion in 1959 The municipality without treatment facilities has a population of 677, according to the 1950 census. Plans have been prepared, but construction has been delayed because of financing problems. Two of the existing plants need replacement and seven need enlargement to catch up with the growth of the community.

"Industrial wastes are generally discharged through the municipal sewer systems. Large industries with separate waste outlets include two paper plants, one oil refinery, and two taconite plants. There are also 118 active mining properties. These plants all have waste control and treatment programs underway and have made substantial progress in waste reduction.

"There are 60 active mining properties served by 42 waste disposal systems consisting of settling basins for clarification of red water. There are also 23 active ore concentration plants with ponds to collect tailings and two taconite processing plants. Tailings are discharged directly to Lake Superior from one taconite plant, and the other plants have extensive ponding areas in all cases. Over 90 percent of these tailings basins have provisions for reuse of the water.

"The School of Public Health at the University of Minnesota, under contract with the Minnesota Department of Health for the State Water Pollution Control Commission, has conducted studies of the physical and chemical characteristics of the lake along the north shore since 1956, and have published three annual reports on the subject.

"The State water pollution control commission, which was established in 1945, is responsible for the administration and enforcement of laws pertaining to pollution of any of the waters of the State. The commission consists of four ex officio heads of State departments and three members appointed by the Governor. The State board of health is directed to make such investigations and provide such other services as the commission needs in its administration of the Water Pollution Control Act. This activity is assigned to the section of water pollution control, division of environmental sanitation."

By Theodore F. Wisniewski, director of the Wisconsin Committee on Water Pollution by letter dated July 16, 1959:

"WISCONSIN

"The Wisconsin Committee on Water Pollution was created by act of the 1927 legislature. It consists of the State chief engineer, a member or other representative of the public service commission designated by the commission, a conservation commissioner, or an employee designated by the conservation commission, the State health officer or a member of the board of health designated by the board, and the State sanitary engineer or other engineer appointed by the State board of health.

"The committee has divided the State into 28 major drainage areas and has directed that detailed surveys of all sources of waste, as well as the effect of the wastes on receiving streams, be made. These surveys have been completed in all drainage areas, and orders for abatement of pollution have been issued to 1136 sources over a period of years. By January 1, 1959, pollution has been abated at 614 sources of waste, and a vigorous followup program is being pursued to gain compliance with the remaining orders as promptly as possible. Where necessary, cases are referred to the attorney general for legal action.

"Abatement of pollution of the Great Lakes, and sources nearby on tributaries, has been accomplished by means of orders and by issuance of recommendations where local sources sought the assistance of the committee staff.

"On Lake Superior, in recent years, treatment facilities have been completed by the cities of Superior, Ashland, and Washburn. Construction is nearing completion on facilities for the city of Bayfield. In addition, Hurley, on the tributary Montreal River, has built primary treatment facilities. Industries providing separate treatment facilities include the Lake Superior Refinery, the Marathon Corp. at Ashland, and the railroad shops at Superior.

"Along the Lake Michigan shore, complete treatment facilities have been provided by the cities of Sturgeon Bay, Two Rivers, Sheboygan, and Milwaukee, and the city of Manitowoc has secondary treatment under construction as an addition

to existing primary facilities. The cities of Algoma, Kewaunee, Port Washington, South Milwaukee, Racine, and Kenosha provide primary treatment facilities. The city of Green Bay and adjoining areas are tributary to the Green Bay Metropolitan Sewerage District where treatment by primary facilities and high rate trickling filters remove 65 percent of the pollution load.

"Major waste-producing industries in Great Lakes cities are connected to the available municipal treatment facilities. Separate treatment is provided by the Peter Cooper Corp., Glue Division, at Carrollville, and by sulfite pulp manufacturing plants at Green Bay. Some of the industries in the cities are required to pretreat wastes before discharge to the municipal systems.

"Rcent surveys indicate that residual in the effluent after treatment or utilization of spent sulfite liquor by pulp and paper mills along the Fox River and at Green Bay still has an adverse effect on portions of Green Bay waters. All of these mills and other sources along the stream have been ordered to reduce pollutional load discharged to the stream by 75 percent in order to eliminate adverse conditions.

"Marinette on Green Bay provides primary treatment. Complete treatment is provided by Oconto and Peshtigo located on tributaries to Green Bay. Pulp mills provide for disposal by land disposal and by ponding with controlled discharge during high flows.

"Pollution of the Great Lakes has been substantially reduced by all communities and industries along the shores and tributaries in Wisconsin, and there is no discharge of untreated waste except under unusual circumstances."

By Clarence W. Klassen, technical secretary of the Illinois Sanitary Water Board by letter dated June 29, 1959:

"ILLINOIS

"Attached is the status of our Great Lakes Basin water pollution control progress, both municipal and industrial. I know that you appreciate that we have a relatively small area under the jurisdiction of the State sanitary water board. As a matter of fact, only the North Shore Sanitary district which encompasses the very narrow area in Lake County.

"The Metropolitan Sanitary District of Greater Chicago has frontage on the lake which is part of the State of Illinois. Statements have been made, although obviously I cannot verify these, that there are no wastes going into Lake Michigan from the Metropolitan Sanitary District of Greater Chicago. It is my suggestion that you address a letter to William Dundas, manager of the sanitary district, and make inquiry concerning this.

"That portion of the Great Lakes Basin in Illinois that is under the jurisdiction of the State outside of the Metropolitan Sanitary District of Greater Chicago is under the control of the State sanitary water board. This board is composed of the directors of the State departments of public health, conservation, agriculture, public works and buildings, and two additional members, one representing industry and the other municipalities. The chief sanitary engineer of the State department of health is the administrative officer and the technical secretary of the board and all technical work is done in the division of sanitary engineering of the State department of public.health. The board meets on the average of once a month. One of the advantages of the Illinois setup is the fact that all phases of water pollution control are represented on the board."

Mr. Klassen's progress report continues:

"*General.*—The natural drainage into Lake Michigan from Illinois as it now eixsts is confined to a relatively short distance inshore. In Cook County surface water only discharges to the lake because the Chicago River has been reversed to drain into Illinois River Basin. Also the Grand Calumet River together with Little Calumet River discharges through the Cal-sag Channel to Illinois River Basin. Waters may also be diverted through the North Shore Channel to the Chicago River. All interior sewage flow is discharged through streams to Illinois River Basin after treatment.

"In Lake County the Continental Divide is within 1 to 3 miles from the shore. The streams paralleling the lakeshore west of the Divide are tributary to the Chicago River system previously described. The entire lakeshore drainage area, except that area included in the U.S. Naval Training Center, Fort Sheridan, and Camp Logan, is within the North Shore Sanitary District which has responsibility for providing sewage treatment plants.

"The following treatment works extend from north to south:

"1. Camp Logan National Guard Camp—a complete trickling filter sewage treatment plant with chlorination supplied on an intermittent basis.

"2. Johns-Manville Corp. Settling lagoon for suspended particles with discharge to lake. Sanitary sewage tributary to Waukegan plant.

"3. Griess-phleger Tanning Co.—Chemical precipitation and settling with discharge to Waukegan plant or to lake.

"4. Waukegan Sewage Treatment Works, North Shore Sanitary District—Enlargement under construction with addition of modified aeration to the existing grease removal chemical precipitation, Imhoff tank, settling and chlorination. Design capacity 96,500 persons at cost of $1,100,000. This plant treats entire city of Waukegan adjacent industries, Illinois Beach State Park, and the villages of Winthrop Harbor and Zion. The latter two communities are now served by an interceptor extending from Waukegan to the north which permitted abandonment of the sewage plants.

"5. North Chicago, American Steel & Wire Co.—Iron Salt Recovery Plant in conjunction with removal of acid discharges formerly going to the lake. About $100,000 was spent in sewer separation. Sanitary wastes discharge to North Chicago plant.

"6. Abbott Laboratories—an activated sludge plant increased in capacity with turbine aeration to accommodate 1.5 mgd flow of pharmaceutical wastes. Effluent is chlorinated. A treatment process undergoing intensive study. Original plant cost in excess of $350,000.

"7. North Chicago sewage treatment plant NSSD—A high rate trickling filter and settling tank was installed about 2 years ago at a cost of about $366,000 to raise plant capacity to a population equivalent of 36,000. Effluent is chlorinated.

"8. Pettibone Creek receives variable waste of industries which neutralize acid waste before discharged.

"9. U.S. Naval Training Center main plant consists of complete treatment by separate sedimentation, sludge digestion, trickling filters, and chlorination. (An interior plant tributary to Chicago River system treats installations west of Continental Divide.)

"10. Lake Bluff sewage treatment works, NSSD—An Imhoff tank plant with chlorination serving a population in excess of about 3,000. Submerged outfall sewer recently extended.

"1. Lake Forest, NSSD—An Imhoff tank with chlorination discharging through a recently extended submerged outfall sewer serves a population of about 9,000.

"12. Highland Park, NSSD.—Three lake plants serve this part of the community. All of the Imhoff tank variety with chlorination through recently extended submerged outfall sewers. Two plants west of the Continental Divide provide treatment for other parts of Highland Park, parts of Lake Forest, and the city of Highwood. One of these plants known as the Clavey Road plant uses the activated sludge process with capacity for 34,000 persons.

"13. North of Highland Park the Fort Sheridan sewage treatment plant treats all sewage by separate sedimentation, sludge digestion, trickling filter, and chlorination.

"The sanitary water board and NSSD cooperated in two consecutive summer surveys of the bathing beaches and waste discharges on the shores of Lake Michigan in 1947 and 1948. Studies have been continued by NSSD and include daily sampling for bacterial results from the Wisconsin line to Cook County."

Following up Mr. Klassen's suggestion, a letter request was sent to Mr. Dundas under date of July 7, 1959. I was certain, despite our official differences of opinion over the Chicago diversion issue, that my one page letter would bring a reply, but I have failed to receive one. Two paragraphs of my letter read as follows:

"Apparently the district is in effect the ninth Great Lakes State insofar as its independent jurisdiction to control pollution along the Cook County frontage on Lake Michigan. As I have been involved in testimony on behalf of our State on the Chicago diversion matter, I might be less charitable in my writeup than you would be in yours. I would appreciate it if you would be good enough to provide me with a one page progress report covering the district's control of pollution along the Lake Michigan frontage.

"I believe I am correct in the assumption that the district is responsible as to standards maintained, solely to its board of trustees and electorate; neither

the High Court nor the State of Illinois exercises any supervision or jurisdiction over your operations."

By B. A. Poole, technical secretary of the Stream Pollution Control Board of Indiana by letter dated July 10, 1959:

"INDIANA

"The Indiana Stream Pollution Control Board, which was created by chapter 214, acts of 1943 of the Indiana General Assembly, is charged with the responsibility of controlling and preventing pollution in the waters of the State.

"The board consists of three ex-officio members: the secretary of the State board of health, the director of the department of conservation, and the Lieutenant Governor, and four members appointed by the Governor, no more than two of which shall be of the same political party. It is of interest to note that none of the appointed members have ever been replaced other than by resignation at the pleasure of the respective member. The State sanitary engineer of the State board of health serves as technical secretary to the board.

"The board holds 10 to 12 meetings each year for consideration of approval of plans for pollution abatement facilities, consultations with municipalities and industries regarding compliance with the board's recommendations, and to take necessary action to insure active participation by all concerned in the pollution abatement programs. It issues about 12 orders per year, following hearings by individual members of the board.

"The following paragraphs summarize the water pollution control progress in the Great Lakes Basin area. Sewage treatment facilities are provided for communities with a total population of over 700,000. To the best of our knowledge none of the interstate waters in the basin are deleteriously affected at the State boundaries by sewage or wastes discharged within the State of Indiana.

"*Calumet River Basin (portion tributary to Lake Michigan)*

"The seven sewage treatment plants located in this basin that discharge to streams tributary to Lake Michigan provide treatment for 98 percent of the population (1950 census) served by community sewer systems. The two communities not served by a sewage treatment plant are presently planning for construction of the necessary facilities.

"Thirty-five of the thirty-seven industries in this basin with waste discharge to Lake Michigan or tributaries thereto provide adequate treatment or control facilities.

"*St. Joseph River Basin*

"Nine sewage treatment plants in this basin provide treatment for 96 percent of the population (1950 census) served by community sewer systems. One of the six communities not served by a sewage treatment plant is under order of the stream pollution control board to construct facilities. One other community has started a cumulative fund to help finance construction of a plant.

"Fifty-nine of the sixty-six industries in this basin have constructed industrial waste treatment or control facilities. Two of the remaining industries are presently planning for the construction of treatment facilities.

"*Maumee River Basin*

"Seven sewage treatment plants provide sewage treatment facilities for 97 percent of the sewered population (1950 census). One of the three communities with a sewer system and no treatment has final plans approved for sewage treatment facilities.

"Thirty-six of the forty industries in this basin have constructed waste treatment or control facilities."

By Loring F. Oeming, Chief Engineer of the Michigan Water Resources Commission:

"MICHIGAN

"*The commission*

"Control over pollution of Michigan's water resources is vested in a seven-member commission consisting of four ex officio members and three citizens appointed by the Governor for staggered 3-year terms. The ex officio members are the commissioner of health, State highway commissioner, director of conservation, and director of agriculture. Commission members appointed by the Governor, subject to senate confirmation are representative of industrial managements, municipalities, and conservation organizations. Thus, all major water interests are represented on the commission.

"Municipal pollution control

"In the 10 years of its existence the water resources commission has issued abatement orders to 100 municipal units of government covering 101 separate problems, and in addition, has administered 10 orders issued to municipalities by the predecessor steam control commission. Legal proceedings, instituted against 49 municipalities for failure to comply, have resulted in court decrees affirming these orders in 48 cases. To date, 80 municipalities have completed their abatement projects, 46 in compliance with the administrative orders, while 34 have proceeded from court decrees affirming these orders. Currently 12 municipalities are proceeding with construction of pollution abatement projects required by court affirmed commission orders, while two are constructing projects in compliance with commission orders.

"In addition, through this 10-year period, pollution abatement has been provided voluntarily by 85 municipal units through the construction of 26 new sewage treatment plants and by replacement, alteration, or expansion of 20 existing plants. Including the 118 plants built and in operation prior to July 1949, there are now 198 plants providing treatment for the sewage of 254 units of government representing well over 90 percent of Michigan's urban population in the Great Lakes Basin. With the projects now underway and scheduled for completion by the end of 1960, all sewered municipalities with a population of over 6,500 will have facilities for treatment of sewage. There will remain but two in the 5,000 to 6,500 group which have no treatment.

"Industrial pollution control

"On the industrial side, it should be understood that the commission deals directly only with those industries discharging wastes through their own private outlets into waters of the State. In this category are 400 plants of record representing 449 separate waste problems. The vast majority of industries in Michigan discharge their wastes into public sewage collection systems in which cases the municipality owning the system accepts the responsibility for the control of pollution emanating therefrom.

"Of the 449 problems referred to above, 278 are classified in the commission's latest industrial pollution status as having 'adequate control,' and an additional 92 are classified as 'control provided—adequacy undetermined.' Comparative figures for 1953 show 395 problems of which 164 were classified as having adequate control—net increases of 54 and 114 respectively.

"Of the 79 problems representing various degrees of unsatisfactory waste control, 15 are of the 'borderline' variety for which need has not been conclusively demonstrated, and 8 are the result of unreliable operation of facilities otherwise believed to be adequate. An additional 32 problems are expected to be brought under control upon completion of projects now being actively planned or which are already under construction. Of the remaining 24 problems, pollution abatement orders have been already issued in 8 cases, and are being considered in 15 others.

"Of the 278 problems classified as being under control, 199 have attained that objective without benefit of an administrative order—a fact which speaks well for the commission's policy of 'cooperation and persuasion,' as well as for industry's acceptance of its responsibility for controlling pollution.

* * * * * * *

"While placing pollution from existing sources under control, pollution from new or increased uses is maintained currently under the 'new use' provisions of the Water Resources Act. Over the 10-year period just ending, 124 orders of determination have been issued setting restrictions on the character of the effluents to be discharged from new industries and expanded existing industries. The orders require that treatment or control facilities necessary to comply with the restrictions be placed in operation coincident with the new or increased discharges of wastes.

"Control over increased discharges from municipalities has been exercised since the initial meeting of this commission in July 1949 by the State health commissioner. His statutory authority to review plans and issue construction permits for municipal sewers and treatment plants, and to supervise their operation has served to meet the statutory restriction imposed on this commission against new municipal pollution."

By Karl M. Mason, director, Bureau of Environmental Health of the Department of Health of the Commonwealth of Pennsylvania by letter dated July 7, 1959:

"PENNSYLVANIA

"Water pollution control need

"Although Pennsylvania's shoreline on the Great Lakes is small, its interest in water pollution control is great. The city of Erie takes its water supply from Lake Erie, and supplies about 200,000 persons. Industries using the lake include a powerplant, paper mills and steel mills. These industries, as well as fruit processing industries in the borough of North East, also contribute wastes. The Lake Erie shore is extensively used for bathing and fishing. The Presque Isle Peninsula draws as many as 100,000 persons in a single day from the western part of the State.

"Water pollution control agency

"The sanitary water board is the State water pollution control agency. It is empowered by State law to issue permits for sewage and industrial facilities and to require the treatment of such wastes. The board is a part of the State department of health whose employees act as its agents and carry out its requirements. It is composed of seven members comprising the secretaries of health, forests and waters, and mines and mineral industries, the director of the fish commission and three members at large. Under the secretary of health as chairman, it meets monthly to determine policy, issue permits and orders, conduct hearings and other necessary business. Since 1945 it has been carrying out a dynamic clean streams program. Almost half of the sewage and three-quarters of the industrial wastes are treated. Most of the remaining contributors are under orders to treat their sewage or industrial wastes.

"Water pollution control

"The city of Erie has expanded and modernized its sewage treatment plant and now provides complete treatment of sewage from the city and surrounding area. The borough of North East, in a great fruit growing and processing area, provides complete treatment of its sewage for a population of 5,000 and a waste load from fruit processing equivalent to 50,000 persons. Other wastes treated include those from a large steel processing plant, blast furnace wastes and paper mills. All of the sewage and most of the industrial wastes in this area receive complete treatment before being discharged to Lake Erie."

NONMEMBER STATES

By Art Robinson, director of public relations for the Ohio Department of Health and Water Pollution Control Board, by letter dated July 10, 1959:

"OHIO

"Since the adoption of a new water pollution control law in 1951 (which became fully effective September 27, 1952), Ohio has moved forward rapidly in water pollution control efforts.

"Nearly $300 million has been spent on construction of sewage treatment facilities by municipalities in Ohio during the last 8 years. The actual gallonage-per-day capacity of municipal sewage works has been more than doubled, from 500 million gallons per day in 1952 to more than 1,100 million in 1959. In other words, more treatment facilities have been installed in this period than in the previous history of the State.

"During the same period, the number of industries with satisfactory waste treatment has been more than tripled.

"In the Lake Erie watershed specifically, a number of cities on the lakefront itself, which had no sewage treatment prior to 1951, now have such plants completed. Among these are Port Clinton, Oak Harbor, Lorain, Sandusky, Painesville, Eastlake-Willoughby, Fairport Harbor, Ashtabula and Conneaut. In the meantime, Toledo and Cleveland (as well as Akron a few miles up the Cuyahoga River) have expanded their treatment facilities. Rocky River and Euclid are building larger new plants to replace old ones. Lakewood is preparing to expand its plant.

"There are 23 cities in the Lake Erie watershed in Ohio with sewage plants now listed as adequate. Another 10 have plants, which have currently been placed on the inadequate list because of growth of the communities, but 4 of these already have expansions under construction and the others are working on plans for improvements. Another 19 cities are listed as adequate by virtue of tributary connection to the sewerage systems of adjacent communities having sewage treatment.

"There are eight cities still without sewage treatment, but four of these now have plants under construction. Three of the others are suburbs which may be able to make connection with other plants. The fourth presently discharges sewage wastes to underground limestone caverns; there has been no evidence to date that harm results.

"In the Lake Erie watershed in Ohio, there also are 44 villages (municipalities under 5,000 population) with sewage treatment plants considered adequate at this time, plus 6 others with plants listed as inadequate currently. The Ohio Water Pollution Control Board believes that 33 more villages in the area need plants now; 8 of these currently have sewage plants under construction.

"Of industries in the Lake Erie watershed discharging wastes directly to the lake or to streams leading to the lake, 132 now have adequate treatment and 53 others have partial treatment not yet considered satisfactory. Among the latter group, 12 now have additions of treatment in the construction stage.

"There are 13 industries in the watershed still needing treatment, and 4 of these have treatment facilities in the construction stage now.

"The Water Pollution Control Act of Ohio, passed in 1951, created a water pollution control board with administrative, regulatory, and quasi-judicial powers. The director of health serves as chairman. Directors of commerce and natural resources are members. There are two appointive members, one representing industry and one representing municipal government. The board has adopted a procedure which only occasionally calls for formal hearings and orders, yet maintains constant review and steady pressure for pollution abatement. This is based on the issuance of discharge permits to municipalities, industries, and other entities. Steady progress toward pollution abatement merits easy renewal of these permits. Lack of progress results in formal hearings and possible board action. It has been the board's policy to seek compliance first by education and cooperation, using legal procedures only when other methods have failed. Violations are punishable by fines up to $500 a day or imprisonment up to a year, or both. No such penalties have had to be inflicted to date. Only 46 permittees have had to be called up for formal hearings, and during the 8 years, only 8 had to be turned over to the attorney general for legal action. Three of these are pending at the moment, but apparently the communities are about to go ahead with sewage treatment programs."

By Herman E. Hilleboe, M.D., commissioner of health, New York State Department of Health at Albany; a report in behalf of the State water pollution control board, an up-to-date (March 13, 1959) report prepared originally for the International Joint Commission.

"NEW YORK

"*Lake Erie*

"At the northeast end of Lake Erie lies the city of Buffalo which is the start of the highly industrialized Niagara frontier. Practically all the sanitary sewage and industrial wastes from this area is discharged to the Niagara River, the connecting link between Lake Erie and Lake Ontario.

"There is a large steel plant on the shore of Lake Erie which discharges some wastes directly to Lake Erie and some to tributary streams flowing through the property. The Buffalo River, a tributary of Lake Erie, receives considerable wastes. However, because of currents in the lake and the prevailing wind, the effects of these discharges are usually confined to the section of the lake immediately adjacent to the shore.

"A similar pattern for communities and industries as was shown along Lake Ontario prevails along Lake Erie. The centers of population and industrial plants are located so that their discharges are into tributary streams rather than directly to the lake. As a result, the effects on Lake Erie are only noticeable, under ordinary conditions, in the immediate vicinity of the tributary streams. Further details on some of these tributary streams can be obtained from our survey reports on Cattaraugus Creek, Silver Creek, and Big Sister Creek.

"This similar pollution pattern applies to the watershed of Lake Erie southwest from Silver Creek to the New York-Pennsylvania State line with the exception of a condition at Westfield. Here there are several seasonally operated grape processing plants the wastes from which are discharged directly to the lake.

"Plans are underway to complete the preclassification survey of Lake Erie and the remaining unsurveyed tributary watershed.

"*Lake Ontario*

"There are very few significant discharges of raw sewage or untreated industrial waste directly into Lake Ontario. Most of the communities and industries in this watershed are located inland where wastes are discharged to tributary streams. While some of these inland waterways might be considered rather heavily polluted, natural purification processes provide some degree of treatment with the result of minimizing the effects on Lake Ontario in the vicinity of the mouths of the tributaries.

"A comprehensive report on the pollution problem in this watershed may be found in the recent classification report of the water pollution control board. The situation on tributary systems omitted from this report have been covered in the individual reports for Eighteenmile Creek, lower Genesee River, Mill Creek, Irondequoit Creek, Black River, and Oswego River. At the present time the report on Eighteenmile Creek is being printed.

"This year the preclassification survey for the upper Genesee River is being planned. These reports, together with their appropriate comprehensive abatement programs, will spell out the pollution problem for this drainage system within the State.

"*Pollution abatement summary.*—The following summary gives details of status of pollution abatement programs along Lake Erie, Niagara River, Lake Ontario, and the St. Lawrence River in New York State.

"*Lake Erie*

"Westfield: The plan for the renovation of the Westfield sewage treatment plant calling for the discharge of treated sewage and industrial wastes to the lake has been postponed temporarily.

"Evans-Angola: The study of the sewerage situation in this area has continued.

"Silver Creek: Promotion work for the construction of a sewage treatment plant for this community has continued.

"Dunkirk: Additions and alterations to the sewers and sewage treatment plant have been completed. More work is contemplated in revamping the existing sewer system.

"General: Industrial wastes are generally under treatment. The sanitary sewage from municipalities is adequately treated but there are individual places needing correction.

"The Buffalo River industries and the city of Buffalo have agreed on a proposal to provide Lake Erie water for plant use and to maintain adequate flows in the Buffalo River.

"*Niagara River*

"Niagara Falls: In progress is a study of the sewage treatment plant to determine the efficiency of process.

"Lewiston: With the assistance of Federal aid, a sewerage system serving this community is under construction.

"General: All other municipalities in this area adequately treat their sewage but several have studies underway for additions and alterations.

"Most of the industrial wastes in this area are being treated. With reference to the others, treatment plants are being constructed or the wastes are under study.

"*Lake Ontario*

"Wilson: Revised plans for alterations and additions to the sewage treatment plant have been approved.

"Olcott: Plans have been prepared for sewers and sewage treatment facilities for this area.

"Rochester: The long-term project for the correction of conditions in this area is being continued and, as a result, the Tryon Park project was completed and additions and alterations to the main sewage treatment plant are under construction.

"Youngstown: The sewage from this community has been treated by means of an adequate primary sewage treatment plant.

"Irondequoit Bay: A new sewage treatment plant serving the town of Pittsford, S. Dak., is under construction. The town of Henrietta, S. Dak., is advertising for bids for the construction of a sewerage system.

"Webster: Additions and alterations to the sewage treatment plant for this community have been completed with the aid of Federal money.

"Oswego: Work is required to correct conditions at the city of Oswego.

"Watertown: The water pollution control board has initiated steps in the enforcement of the comprehensive abatement program applying to this city.

"General: Industrial wastes are not a problem in this area. Other municipalities in this section have adequate sewage treatment facilities. There are some areas where individual correction is needed.

"*St. Lawrence River*

"Ogdensburg: Work is required to correct conditions at the city of Ogdensburg.

"Massena: A sewage treatment plant serving this community is now under construction. Federal aid was granted for this project.

"General: Industrial wastes are not yet a problem in this area. With the electrical power now available in this area and the possible development of ports along the St. Lawrence Seaway, there will be an increase in industries which will have to be followed by the water pollution control board."

By Dr. Albert E. Berry in behalf of the Ontario Water Resources Commission.

"PROVINCE OF ONTARIO

"The Ontario Water Resources Commission was created in 1956 and began its activities the following year. This legislation has two main functions—one to control water and sewerage installations in the Province of Ontario, the second to assist municipalities by constructing these works for them. As a result of this legislation considerable progress has been made along the boundary waters. The following information indicates the action taken, and what is proposed:

"Fort William and Port Arthur: A sewage treatment plant is under construction in Port Arthur, and plans are now being developed for a plant at Fort William, so that both cities will be supplied with these facilities shortly.

"Sault Ste. Marie: Tenders are being called for the construction of trunk sewers and a sewage treatment plant to serve that city and adjacent territory.

"Sarnia: A sewage treatment plant is now under construction along with the necessary trunk sewers. The village of Point Edward adjacent to Sarnia is also constructing a treatment plant.

"Riverside and adjacent territory: Plans are being developed for the construction of a new sewage treatment plant to replace the existing one to provide a greater degree of treatment.

"Windsor: No active start has been made on an extended sewage treatment plant, but the council is ready to discuss this, and it is believed to proceed with the necessary works.

"Amherstburg: An engineering report is near completion and arrangements have been made for this construction to take place at an early date.

"Leamington: Arrangements made for construction of a sewage treatment plant.

"Port Dover: Action being taken to start work on a sewage treatment plant.

"Fort Erie: Primary work completed for the construction of a new sewage treatment plant.

"Hamilton: Sewage works now under construction.

"Toronto area: Sewage works under construction to be completed in 1961 to give treatment to the entire area.

"Belleville: Work being undertaken on the construction of a new treatment plant.

"Brockville: Work to be undertaken on treatment plant as soon as work now being carried out on a water intake is completed.

"Cornwall: Sewage treatment works expected to proceed in the immediate future.

"From this, it will be seen that the works undertaken or planned in this Province along the Great Lakes will effectively deal with pollution from municipal sewers. At the same time, action is being taken to deal with the industrial wastes in all of these municipalities. They are asked to provide the same protection of the waters as are the municipalities."

STATEMENT BY G. S. MCINTYRE, DIRECTOR, MICHIGAN DEPARTMENT OF AGRICULTURE

Agricultural water problems are not new to this State. Inically the problem was one of water removal. This has been effected satisfactorily, as a whole, under the drain laws of the State, to permit the development of large areas of some of the most productive agricultural lands in the Nation.

Today, the water problems of agriculture are more complex. The present trends of agriculture in Michigan will make agriculture increasingly sensitive to the matter and methods of total water management, its conservation, utilization, and disposal. Over 75 percent of Michigan's crop harvest land is located in the southern portion of the State, the same area in which one of the largest and fastest population growth in the Nation is occurring; and the same area that already contains more than 90 percent of the people of the State. Pressed also by economic conditions, Michigan agriculture is constantly improving its production efficiency. In all, this results in increased competition for the resources of land and water, and a greater intensity of the use of these resources.

From this situation the very real and serious problem of water rights becomes more and more evident and widespread. Michigan farmers are now using supplemental irrigation in the production of high-value crops and it is safe to assume from the present trends that there will be a considerable increase in this practice in the next 20 years. Over 60 percent of this supplemental irrigation is from surface waters. Michigan has no water rights law to protect the water rights and the investment of an irrigator.

We believe that it will be beneficial to expand the water resources factfinding program with the coordination of the U.S. Geological Survey, Michigan Department of Conservation, the Water Resources Commission, Michigan State University, University of Michigan and such local governments that are willing to cooperate.

We further believe that the Michigan Legislature should continue the study of the water rights problem. And we also believe that it would be timely for the Michigan Legislature to enact initial water rights legislation to establish that irrigation is a reasonable use of the waters of the State.

We see no need for Federal legislation in the matter of water rights in the State. However, any Federal water rights legislation should not be in conflict with a Michigan water rights law.

The increased intensity of land use, both rural and urban, also creates greater problems of water disposal, and a greater need and urgency for relief. The threat to the public welfare and of economic loss becomes greater and greater.

The participation of the Federal Government in flood prevention and drainage projects both rural and urban, has been of great benefit to the people of Michigan, and we urge the continued participation of the Federal Government in such projects.

However, it is our belief that the effectiveness of such Federal participation can be increased by a separation of the agricultural flood prevention projects from urban flood prevention projects. Two Federal agencies are now involved in Michigan in the planning of agricultural flood prevention projects, those being the U.S. Department of Agriculture Soil Conservation Service and the U.S. Corps of Engineers. Each agency should be handling the type of project most suited to its particular qualifications and experience. Certainly we believe this will facilitate action, eliminate the confusion of the local people and end the awkward uncertainties that must plague both agencies in such a situation.

We further believe that the effectiveness of the U.S. Corp of Engineers would be considerably greater if their efforts could be directed toward a singleness of purpose in planning and seeing to completion only such flood prevention projects which the people, through their local units of government have requested and are ready to proceed with.

We believe that the program of watershed planning studies and hydrological data accumulation should be expanded. This should be a coordinated program which includes such agencies as the Michigan State Highway Department, Water Resources Commission, Michigan Department of Conservation, Michigan State University, University of Michigan, the U.S. Geological Survey, U.S. Agricultural Research Service, U.S. Weather Bureau and any local units of government that may wish to cooperate.

Mr. ADAMS. I would like to tell you why I have supplemented my report with the various exhibits. Knowing as well as I do and favorably the staff people serving your committee, John Mutz and others, over the years, I know they want to have grist to grind, to come up with in this report.

Most of these exhibits will be found to acquaint your staff with what we are thinking here in Michigan, what we are doing, the problems we are encountering with respect to our water resources, and how we feel perhaps that Federal assistance is in order.

First of all——

The CHAIRMAN. May I ask you a question before you start?

Mr. ADAMS. Yes, Senator.

The CHAIRMAN. I notice you say that your annual $650-million tourist and resort industry can be served. I have been trying to get into this record for some time the figure accurately depicting the total recreational industry expenditures in the Nation. I am sure that with access to the sources that give you the $650-million figure maybe you could provide that for this record. If you could it would be a great service to us.

Mr. ADAMS. I do not have it today, sir.

The CHAIRMAN. It would be fine if it could be supplied.

Mr. ADAMS. I will make the point to do what I can to provide your committee with that information if it is available.

The CHAIRMAN. We would be grateful.

(The information referred to follows:)

STATE OF MICHIGAN,
WATER RESOURCES COMMISSION,
Lansing, Mich., November 6, 1959.

Hon. ROBERT S. KERR,
Chairman, Select Committee on Water Resources,
Senate Office Building, Washington, D.C.

DEAR SENATOR KERR: You may recall the inquiry you put to me when presenting my statement before your committee in Detroit on October 29. It has been answered in Mr. Furlong's letter to me of November 4, verifax of which is attached.

As against this $18,735 million total for the Nation, $650 million was the figure I gave you for the State of Michigan.

When I have received an answer to your second inquiry—that being the type of fuel used by our steam generating powerplants in this State, you will hear from me again.

Very truly yours,

MILTON P. ADAMS, *Executive Secretary.*

STATE OF MICHIGAN TOURIST COUNCIL,
Lansing, Mich., November 4, 1959.

DEAR MR. ADAMS: The National Association of Travel Organizations estimates recreation and vacation travel expenditures in the Nation for 1958 at $18,735 million.

Mr. James L. Bossemeyer, executive vice president of the National Association of Travel Organizations with offices at 1422 K Street NW., Washington, D.C.,

tells me that this is the most authoritative figure available and that their estimates are on the conservative side.

This is the information requested in your letter of November 3, and I hope it will be helpful.

Sincerely yours,

MICHIGAN TOURIST COUNCIL,
ROBERT J. FURLONG, *Executive Secretary.*

The CHAIRMAN. I notice you talk about your generation of electric power and steamplants. What are the relative amounts of energy fuel utilized, or would you know?

Mr. ADAMS. As to that I cannot say. I do know that Michigan, because of its topography, has not lent itself to the development of hydroelectric power——

The CHAIRMAN. I understand.

Mr. ADAMS. As your State has and others in the Southwest through storage of water and multipurpose use.

The CHAIRMAN. I would presume that your generating facilities use both coal, oil, and gas as their energy fuel, and if your office has access to the information of the use of those fuels percentagewise I would appreciate your putting that in the record.

Mr. ADAMS. We will seek that, sir.

The CHAIRMAN. Thank you, sir.

(The information referred to follows:)

STATE OF MICHIGAN PUBLIC SERVICE COMMISSION,
Lansing, Mich., November 17, 1959.

Mr. MILTON P. ADAMS,
Executive Secretary,
Water Resources Commission,
Lansing, Mich.

DEAR MR. ADAMS: In response to your letter of November 12, we have compiled certain data which I trust will give you the information desired.

	Kilowatt-hours
Production of electric energy in Michigan by electric utilities for year 1958:	
By waterpower	1,493,289,000
By fuels	22,544,842,000
Total	24,038,131,000
Production of electric energy in Michigan by industrial establishments for year 1958:	
By waterpower	108,318,000
By fuels	4,679,450,000
Total	4,787,768,000
Total utility and industrial production for 1958	28,825,899,000
Consumption of fuel for year 1958 by Michigan electric utilities for production of electric energy:	
Coal	[1] 9,222,406
Oil	[2] 527,511
Gas	[3] 1,073,800

[1] Short tons.
[2] 42-gallon barrels.
[3] Thousand cubic feet.

The above data was taken from a publication entitled "Electric Power Statistics" of the Federal Power Commission.

Yours very truly,

NORMAN BERKOWITZ,
Secretary.

Mr. ADAMS. I can list these water resources here in Michigan from the first page of my report. They consist of the flow within some 36,350 miles of rivers and streams, and the waters of its 11,037 inland lakes.

The State's portions of the Great Lakes, which comprise some 39,000 square miles of water in Lakes Superior, Michigan, Huron, St. Clair, Erie, and their connecting rivers, and the developed and undeveloped bordering shoreline on these waters, amounts to some 3,251 miles.

Our water resources are in our ground water reservoirs of variable quantity, quality, and availability. These underlie much of the 57,000 square miles of emergent land area of the State.

All of these resources are maintained quantitatively by the State's average annual precipitation of 31.7 inches.

It is important, however, in that connection in studies recently made of the outflow of Lakes Michigan, Huron, and Superior to note that whereas that average rainfall over this entire area is around 30 to 31 inches a year, we can only account in studying the discharge records of the St. Clair River for about 10, I believe, or 11 inches of that total precipitation. So we do lose, as a result of evaporation, transpiration, and other sources about two-thirds of the normal precipitation that we have fall on our Great Lakes watershed.

That perhaps is one of the motives which actuates our State in watching closely what it does have and which it has to enjoy in connection with the other Great Lakes States.

Now in my statement I have just covered by apportionment here some five subjects and those very briefly.

Senator Kerr, you touched on the first two, recreation and power.

Thirdly, our resources must provide the municipality and industrial supplies of our State, and these we figure to be something over 2 billion gallons a day that are used for this purpose.

We have in point 4, agriculture, a growing problem which is yet uncontrolled by State law. We feel that it is a problem and a challenge for State law to meet and that is the growing use of particularly our surface waters for diversion from our surface water streams, for supplementary irrigation purposes.

Our State, and I know I do not need to remind you, Senator Kerr, operates under this reasonable use doctrine, long held by the courts. Everyone in his turn is entitled to make a reasonable use of the water. He is charged with the responsibilty, however, of returning it to the stream from which it is used, undiminished in quantity and substantially unimpaired in quality. That is the thing that supports us in our pollution control program.

When we begin to withdraw our permit, the withdrawal particularly during summer months of portions of that critical streamflow which drops to low value, then we are embarrassing ourselves with respect to serving population and industry and supplies. That is a problem, we submit, which the State must work out for itself. I know you share that view.

Finally, we come to the matter of the service performed by these waters.

The CHAIRMAN. Before you leave agriculture, do you know what part of the area irrigated received the water from underground sources?

Mr. ADAMS. You will find, sir, in exhibit 12, I think it is, in my book here, the last one—exhibit 15—that there is a summary just completed of the water used for irrigation in our State and I believe there is a division made between the water which come from underground sources and that which comes from surface water sources.

The CHAIRMAN. Fine.

Mr. ADAMS. Finally, the problems with which our commission is familiar and is working on are listed here on page 2. There is, first, the need in our State of not less than $100 million per year of municipal water and sewage facility construction. Notwithstanding the fact that we have the encouragement of sewage disposal construction grants, our total for the 2 years of which we have record from the Public Health Service figures indicate that 2 of the last 4 years have only provided an expansion of $50 million. We are falling behind in that. There is some Federal concern. There is a great deal of State concern.

My exhibit No. 4, attached, gives you the complete record based on the returns from local officials of their estimate of water and sewer needs within our State as of 1955. That was prepared and submitted to Governor Williams at his request at that time.

During the 4 years that have passed, this construction has gone forward but not at a rate sufficient to overcome this $1 billion backlog that is still to be met, perhaps more.

Ed Connors, of Wayne County committee for six counties in southeastern Michigan, has a *higher figure than we have carried. The* Detroit Metropolitan——

Senator HART. May I interrupt here and, *for the record, caution* you that Councilman Connors is in the room. I saw him come in. I hope he is still here. So you should be guarded in any dispute *that you undertake at the moment.* We are very grateful.

Ed, would you stand so I may introduce you to Senator Kerr.

Mr. ADAMS. I am sure he will not dispute the last part.

I never run away from arguments and I like them.

*Finally, we put in this exhibit the record of what we are attempt*ing to accomplish. We feel as a result of the inability to handle many applications made *to us that H.R. 3610 that is still pending* I believe in the Congress, should have your favorable action.

With respect to the subject of flood control we advocate a new approach to the ascertainment of these problems throughout our State as well as other States, seeking an appraisal of what these problems are and appropriate action taken encouraged by the Federal Government but participated in by local and State governments toward the prevention of floods on a longtime basis, the prevention of such location as we now fight within flood plains.

We have one exhibit in here showing the flow characteristics of the representative Michigan rivers; that is exhibit No. 13.

This shows that the average summer flows in our streams are so low as to be away below the average and they limit the expansion of industry and population because of that fact. We would like to see more encouragement with respect to Federal participation in the augmentation of summer streamflows.

No. 4, we have a problem of beach erosion control which this commission is authorized to participate with local governments in an

attempt to solve. You are aware, of course, of the activities of the beach erosion board. There is a difference and a serious difference, we believe, in the protection of frontage under the Beach Erosion Act and in the Flood Control Act. We would ask that the committee give attention to that difference and see if there is not some way of reconciling the practice for the protection of privately owned property suffering from high levels and onshore winds.

Following the high water of 1952, there has been authorized, as a House Public Works Committee resolution, the study of the levels of the Great Lakes. We seek and we need within Michigan a more stabilized and less wide range of fluctuation of level, in Lakes Huron, Michigan, and in Erie. As you know the level of Lake Superior is already controlled by the joint Canadian-American Board of Engineers, and we believe that Lake Ontario is similarly to be controlled. We still await, Mr. Chairman, the report of the Corps of Engineers on this lake level stabilization. We think it is now due for 1960. We are disappointed, I believe, in reading that appropriation bill curtailed that again. I believe it was one of the President's recommendations. But if these Great Lakes States are to know what level they are to work against in these lakes we should have that engineering information as rapidly as it can be obtained.

I have already appeared before your committee at times on pollution control legislation. I only bring forward in this report mention of two problems, first, that which is growing around the matter of navigational use of our waterways, the seaway development, and from the rapidly growing public interest in pleasure craft.

We think that will be expanded on by subsequent speaker but that is a problem that is serious with us. We suffered all through this summer in Berrien County along the 38-mile stretch the damaging effect of oil. I do not think it was Kerr-McGee oil. It was some other material.

The CHAIRMAN. It never damages.

Mr. ADAMS. No. It was floated in a barge, but here we have boys and a captain starting out of the interstate waterway on November 26 last year with storm signals flying. They did not even know what the signals meant. They might well have lost their lives. All of the crew was sick. This barge with 400,000 gallons of oil got away and it smashed into a breakwater over at Gary and that north wind just took that right up. And Indiana did not get a bit. It all hit in Michigan in that fine resort section and the people there suffered grievously this summer because of that.

We think there is something wrong either in Coast Guard legislation or somewhere, where a crew, a green crew without training, can get out on the Great Lakes on a stormy day and run that risk not only of foundering the boats and doing the damage but perhaps losing their lives as well.

I am speaking here for this commission, gentlemen, which consists of Dr. Heustis, this year's chairman; George Liddle, vice-chairman for our municipal group; Gerald E. Eddy, director of conservation, John Mackie, State highway commissioner; George McIntyre, director of agriculture; and Lynn Baldwin, who is here today, representing the conservation group; and Carl Schultz, of the industrial management groups.

This commission will be holding its regular monthly meeting here tomorrow and determining the priority of certain applications under Public Law 660.

I thank you for your time.

The CHAIRMAN. Thank you, Mr. Adams.

I have heard you give statements, and I never fail to be intrigued, interested, and informed. I am delighted to have heard you again.

Senator HART. Dr. Heustis.

Dr. Heustis, Mr. Chairman, is the State Health Commisisoner of Michigan, and an old friend.

STATEMENT OF ALBERT E. HEUSTIS, M.D., STATE HEALTH COMMISSIONER, STATE OF MICHIGAN

Dr. HEUSTIS. With your permission, may I put the charts on the platform? I think it can help presentation.

Senator Hart and Senator Kerr, first of all, I should like to express the appreciation of the entire Michigan Department of Health at the opportunity to be present this morning and to set forward some of the things that we believe in very strongly. I think the committee should know that while the primary concern of the Michigan Department of Health is with the protection of the public health. We are also cognizant that there are other interests concerning water and it is our philosophy that these other interests, that water be used for these other things to the maximum extent possible with sound public health engineering practices.

I regret that I do not have a sufficient number of the entire document to make available to everyone. Our financial situation as of the moment precludes this. But if there is material in it that the committee would like, we shall endeavor to provide you with these parts.

I thought your time might best be served, and I might make my point with a little more emphasis if instead of reading the document, I went over some of the more important things and made some very specific recommendations for consideration by the Federal Government.

The first general type of thing I would like to share with you are the demands, as far as water for drinking purposes in a single average day. The figures are in the prepared document and I may ask, sir, that the entire prepared document be included and made a part of the record and I will not repeat those here.

The CHAIRMAN. That is very good. We will be glad to have it.

(The information referred to follows:)

STATEMENT BY MICHIGAN DEPARTMENT OF HEALTH ALBERT E. HEUSTIS, M.D. STATE HEALTH COMMISSIONER

In many areas of Michigan legitimate needs and demands of expanding communities are imposing such a critical load on the water resources of the river systems that a new pattern of water use and pollution control has emerged wherein solutions are developed on a basinwide approach. Of significance is the gradual failure of some of the streams to provide for the incompatible demands of the exploding residential, commercial, and industrial population along with those of agriculture.

The Michigan Department of Health has real concern for the demands being placed on the State's water resources and the incompatibility of these uses in many instances. Our concern lies with protecting the public health while at the

same time permitting maximum use, consistent with sound sanitary engineering principles, of the potentialities of the water resource. Moreover, the State health commissioner is charged by law under act 98, public acts of 1913 as amended, with the responsibility for supervisory control over all public water and sewer systems to assure a pure and wholesome water supply and prevent unlawful pollution of the waters of the State.

There are 723 municipal water supplies in the State of Michigan at the present time under the statutory supervision of the State department of health. In almost each instance this results in some kind or type of sewerage system. These water supplies serve approximately 5,700,000 people with an average demand of 915 million gallons per day. On peak days the demand will rise to 1,600 million gallons. The department of water supply in the city of Detroit alone serves over 3 million people with peak water demands in excess of 800 million gallons per day. By 1970 this will increase to 4 million people and over 1,300 million gallons per day, and by 1980 to 5 million people and about 1,600 million gallons per day. It should be understood that all water developed to serve Michigan communities is returned to the Great Lakes drainage basin.

Unfortunately, in nearly all areas of the State where large metropolitan developments are in progress, the river systems are relatively small compared with the demands imposed by the communities for water supply and waste disposal. In each of a half-dozen areas, a dozen or more separate communities, some of which embrace entire townships, must use these river systems for disposal of their wastes, and in some instances, likewise, derive their source of water supply from the same stream. Some of these areas when completely built up will embrace more than 100 square miles. As these communities grow, both residentially and industrially, the capabilities of the river for satisfying these needs become so greatly exceeded that they must be supplemented in some way by utilization of water resources outside the area.

The Rouge River in southeastern Michigan is a good example of a water resource completely out of balance with the needs of the communities which are naturally tributary to it in terms of drainage. This river provides a drainage outlet for most of Wayne County and approximately 140 square miles of Oakland County. Approximately 20 years ago the communities of Wayne County recognized that the flow in the river was so low during summer seasons that it could not carry the burden of assimilation and stabilization of the well-treated wastes of the area without creating conditions of nuisance arising from the river itself and, furthermore, that it was unsuitable as a source of water supply. Accordingly, the communities developed a system of interceptors as a joint county project to transport all of the wastes from the area to the Detroit River where, after treatment, ample dilution was available. During the past year a construction program has been undertaken by Oakland County to develop interceptor sewers serving all of the 140 square miles in that county drained by the Rouge River.

A somewhat similar condition is beginning to develop in the Clinton River Basin. This river has its headwaters near Pontiac and flows for approximately 25 miles through a fast developing residential and industrial area to Lake St. Clair at Mt. Clemens. The city of Utica for many years has derived its municipal water supply from this river. During the past few years it has become increasingly evident to the State health department, as well as to the city of Utica and other communities along the river, that the load imposed by Pontiac and other communities on the river's resource has become so burdensome, even with complete waste treatment, that it is no longer possible for any community on the river to utilize it as a satisfactory source of water supply. Surveys have been initiated and planning is currently underway with the assistance of the Federal Government for the purpose of developing a coordinated system of waste disposal facilities with points of discharge that will utilize the resources of the river to the maximum extent without seriously interfering with other legitimate uses, except water supply. Plans are well underway for augmenting the supply of the several communities in this river valley with water from Lake Huron. Those communities which are growing rapidly at this time, largely in unincorporated areas, are looking with concern upon the problem of financing their share of the interceptor sewers, sewage treatment plants, waterworks intakes and treatment facilities and transmission mains essenial to the development of the framework or backbone of these two systems.

Problems in the lower Huron River are in many respects similar. This river, like the other two, has low flows in the general magnitude of 20 to 40 cubic

feet per second. For many years the several communities in the Huron Valley discharged their well-trained effluents from sewage and industrial waste treatment plants into the river and obtained a portion of their water supply from points on the same stream. At several sites industry and power companies constructed dams for generation of power, and recreation was enjoyed in the waters impounded thereby. A tremendous expansion, both residential and industrial, is anticipated in this area for the immediate future. It is conservatively estimated that by 1980 the city of Ann Arbor may need most of the flow in the river, during periods of low flow, for its water supply. Engineering studies now in progress indicate the incompatibility of the demands on the water resources in the basin and point up that the river is not capable of receiving the treated wastes of the expanded communities, providing an adequate water supply, maintaining water of a quality suitable for swimming and other recreational pursuits, and permitting diversion for irrigation. Under consideration are flow augmentation in the river by storage reservoirs, supplementing local water sources by piping in water from the Great Lakes system, and constructing interceptor sewers to transport sewage from certain areas to more favorable points of discharge. Here, again, problems of financing and the essential framework of these facilities is of concern, particularly to the areas where development is expected to increase rapidly in the presently unincorporated areas.

The Flint River is becoming seriously overburdened by demands of the city of Flint and several other communities for water supply and waste disposal. Even though approximately 17 communities covering well over 300 square miles are not yet sewered and are in the early stages of development, and even though low flow in the river is supplemented by existing storage reservoirs, and with a high degree of waste treatment by the city of Flint and its industries, conditions in the Flint River for several miles below the point of waste discharge are such as to border on a state of nuisance. It is evident that growth in this area must come to a standstill unless large quantities of water are transported from Lake Huron some 75 miles distant to provide both a source of water supply and stream augmentation. Even this is viewed as an interim solution from the standpoint of waste disposal, pending the time when it will be necessary to transport a portion or all of the treated wastes to downstream points on the river system where more dilution is available.

Still another example of the need for supplementing water resources on an intercommunity basis may be found in the Cass River which, like the Flint, is a branch of the Saginaw River system. In this case two large industries, one a sugar beet processor and the other a brewery, have imposed such loads on a river having low flows in the magnitude of 20 cubic feet per second, that it is no longer possible to obtain a dependable, satisfactory water supply from a downriver community, nor is it possible to maintain conditions in the river above a nuisance level for substantial periods during the summer months. Here it is becoming evident that it will be necessary to transport a portion of the treated waste out of the Cass River to a point in the Saginaw River where greater dilution potential is available. The alternative as in many of the other areas is stagnation for both the industries and the communities.

The Saginaw River and its tributaries are another example of competition between industrial and municipal wastes and water supply. The Saginaw River has had to be abandoned as a source of water supply due to industrial waste loadings on the stream. The city of Saginaw together with the city of Midland have had to construct approximately 75 miles of pipeline to obtain water from an unpolluted source in Lake Huron.

Another aspect of the competition between water supplies and waste disposal and the complexity which has arisen due to unprecedented growth in our metropolitan areas has likewise created problems as far as ground water supplies are concerned. In Kent County, on the west side of the State, Wyoming Township at one time was required to abandon two of its three well fields—one because of the brine from a softening plant in an adjoining township being discharged into a water course which was recharging that particaular well field; and the second well field was abandoned due to industrial wastes of a toxic nature entering the ground water formation.

Another example emphasizing the importance of the interrelation of water and sewage treatment between one community and another occurred in Kalamazoo County between Portage Township and the city of Kalamazoo. A land developer in Portage Township planned to install a sewage treatment plant, the effluent of which would have been discharged to a stream running through one of the well fields of the city of Kalamazoo. This incompatibility was resolved by

discharging the effluent downstream from the well field. This same well field had previously been threatened by the proposed disposal of industrial wastes of a toxic-, taste-, and odor-producing nature.

The above examples indicate that these problems are not respecters of political boundaries and that the solutions to such problems must be looked at on an area basis and often on the basis of the entire river basin through cooperation between the various communities.

The solution to these very complex problems must be considered from both the immediate or interim standpoint and, moreover, the long-range standpoint. The immediate or interim solutions are sometimes particularly difficult to achieve since the areas are not completely built up, and therefore revenue-producing potential has not been developed. In most instances there is a satisfactory engineering solution; however, the financing of the project often presents difficulties. The fact remains, though, that most water-supply and sewage problems can be financed directly by the users. These utilities are of such a nature that they can "stand on their own feet." To attain this end the philosophy of the general public in Michigan and the values assigned to a safe and adequate water supply and to a clean stream must be realined and reassessed to the point where there is a willingness to pay the reasonable increase in costs necessary for these services and the great benefits which accrue. Much educational work along this line is necessary, and particularly at the time of consideration of bond issues by local communities. Even after approval of the bond issue by the community there is a period during the early stages when it is quite difficult to meet the principal and interest payments. As the number of customers increase, this problem resolves itself. It is therefore felt that consideration might be given to some type of financial assistance to afford security to bond issues in their early stages. This could be worked out by pledging the full faith and credit of a larger and financially more sound governmental unit such as the county, State, or Federal Government. Special legislation and possibly constitutional amendment might be required. An example where this has worked to an advantage is in Wayne County where the county has pledged its full faith and credit for local projects. Even there it is not anticipated that the county will contribute directly to the cost of these projects, but that it merely pledges its financial support and thereby makes the bonds more salable.

Another facet which needs to be explored in solving these complex water and waste problems is research, and it is believed that the facilities of the Federal Government can be greatly expanded in this area. It is quite necessary that more basic data be obtained on our streams to determine their potential and how it might be increased, both as to load-bearing capacity and as a source of water supply. Furthermore, continual and extensive research is necessary in the fields of water and sewage treatment. These research projects should be pointed toward present treatment methods to increase their efficiencies and to develop new methods. We are also of the opinion that research is necessary in connection with the waters of the Great Lakes to determine the effect of increased populations on plankton loadings which are important characteristics as far as the operation of water-treatment plants are concerned.

It is widely recognized that there is a great need for development of more effective and economical means of treatment of sewage than is known to exist today. Many manufacturers of equipment have been working for the past several years toward these objectives. Each has expressed hope and some confidence that their goal has been achieved at least to some extent. Little knowledge is available in any one place, however, on the extent of effectiveness of equipment or process in terms of performance or savings, as compared with that conventionally installed for the past several years. A thorough evaluation of the processes employed by these several manufacturers should be conducted by an unbiased agency, preferably on a national level, so that the results may be made known and utilized by all. If the savings in facility and operation cost are of the magnitude for which hope is expressed by the manufacturers, utilization of these principles would substantially reduce the financial burden for sewage treatment. Several areas of water treatment, both in the pretreatment phase and filtration, require equal evaluation and have relatively the same promise for savings to the customer.

A tremendous need exists also for evaluation of the performance of small sewage-treatment plants, including the so-called package plants for the individual home, school, and for the small commercial or industrial establishments which do not have access to a municipal sewer. Pending extension of a sewer

system to these areas, it is necessary to provide some method of treatment not dependent upon percolation into the soil. Many of the same manufacturers who make full-scale sewage-treatment facilities have concerned themselves during the past 5 to 10 years with the development of small systems adapted to these uses. Very little information is presently available on the level of performance of any of these types of treatment, or efficiency of the equipment employed for this purpose. The number of homes and other places where treatment facilities of this kind are needed has been estimated by many and the consensus seems to be in the magnitude of over a million installations. Few if any State health agencies deny the need for a better means of disposal for these situations than is now recognized. It seems clear that this is a project so national in scope that it deserves not only national support but a program executed by the Federal Government to provide performance data to clearly indicate the limitations and adaptability of the several types of equipment and processes thus far developed, and to provide a baseline upon which greater improvement may be made by the manufacturers.

The only apparent effective alternative to efficient interim water and sewage systems for isolated suburban areas in the rapidly developing metropolitan complex appears to be a system of controls and zoning which would provide for progressive development from the core city outward. This would require that no plat for development could be approved until municipal water and sewer service was available. As one area developed, service would be extended outward to the adjacent area. It is difficult to imagine that effective controls could be administered to carry out this philosophy.

Further, in the field of research in the area of water pollution control, one of nationwide concern is in connection with the boat or pleasure craft industry. Control over the discharge of sewage and other wastes from these craft is imperative to protect swimming and other recreational areas and waterworks intakes. Research aimed at developing practical and effective waste-treatment devices is needed.

In summary, the solution to problems involving water pollution control and the development of water supplies must often be approached on the basis of a river basin solution, rather than on an individual problem-solving basis, since these problems do not respect artificial governmental boundaries. Water and sewer systems are utilities in the same sense as are gas, light, and telephone companies, and accordingly should and can be self-supporting, but with devices for assuring financial soundness and stability during the early years of a bond issue while the system is acquiring customers. The Federal Government can lend assistance in the area of research on water- and sewage-treatment processes and equipment and the sanitation of watercraft.

Dr. HEUSTIS. These figures may be multiplied almost by two to take care of the demands on the various peak days. That is the 915-million-gallon figure. With the number of municipal supplies, we are very proud there has been no case of outbreak of disease caused by municipal supplies in over 27 years.

The persons served, that you can see, and as these demand, the demands of the public health for drinking water grow also recreational demands grow, the real estate and the land values, the industrial demand for process water and for waste disposition, irrigation and last but not least the assimilation of waste from our municipalities—as the demands grow I am somewhat reminded, Senator Kerr, of the material which we have seen in many cartoons lately of the large number of college kids trying to crowd into a single telephone booth. This is the way almost, it almost seems as though they are trying to use some of the streams.

In addition to the demands growing, we find that we have some troubled waters. We find that unfortunately where we have our larger metropolitan developments in Michigan with the exception of Detroit itself we find that the river systems are relatively small.

We can point to more than a half dozen specific areas in Michigan where more than a dozen communities at the present time use their

small stream for sewage disposal purposes. Some of these same streams are trying to get their drinking water from the same place and there are other functions, too. As our needs grow both in public water supplies and for sewage disposal, industrial needs also grow and others as well.

We believe that the committee would do well in its consideration of the entire problem of looking at this on a river basin approach, taking a river basin approach to the problem solving rather than considering the needs of individual communities alone, for we have learned as is pointed out I think very well, very completely, I mean, in the supporting statement, the instances on these half-dozen river basins that we have used where one community is entirely powerless to plan without taking into effect the communities up and downstream.

If we see these uses increasing and if we allow these streams to be used increasingly for the disposition of human waste and other things, we see people trying to get drinking water out of streams where the water has completely gone through two or three sewage treatment plants. We are not adverse to a little water going through a sewage treatment plant but when you have a potentially dry stream between the water intake and place where the sewage effluent occurs this would make our water wonderland a water wasteland. We are pretty definitely going to see this does not happen.

One of the solutions at least is to tap other sources. This means that some of our communities both have to go afield to get their drinking water and some of our communities have to go afield to dispose of their waste.

This is going to cost more money. But before I talk about money which I would like to talk about next, I would emphasize that along with this problem is the problem of contamination of ground waters by the injudicial disposition of water wastes and we should also be on guard against that.

Now let us talk about finances and in finances comes the real rub in the problem of providing communities with public water supplies and sewage disposal systems.

It costs a great deal more to go to one of the big lakes for water than it does to drive an old-fashioned well point in the backyard. Our folks in Michigan, blessed as they have been with abundance of water, have come to look upon it as free. So when you talk about the cost of transmission of water over miles, when you talk about the cost of pumping sewage over the same miles, this costs money. It is not, in general, as yet looked upon as a public utility the way we believe it should be. We believe very strongly that municipalities must follow the very sound policy established by private utilities in planning for expansion within their lake structures. We believe that folks must be made aware of both the water needs and the cost of providing good water in adequate quantities just the same as they have to be made aware of the need for payment for other utilities which they desire.

There is another rub, too, and that is that the way our cities grow we do not grow right out solidly from a central core. This means that when we plan water mains and sewage collection systems there are gaps in the area served. The potential number of users when a system is first planned is not as great as it would be 5 or 10 years hence and

that makes the potential revenue to be gained through tapping fees and through utility charges not as great as may be expected for the time that the system is planned.

We need to remember that some of these areas are not built up so when these folks go to security financing for their needed construction they have difficult times.

No. 1, their valuation is not, in many times, sufficient to allow them to borrow the money that they need and, secondly, even more importantly, they find the bond buyers very reticient to take a chance on a place with as little potential immediately, even realizing that there is greater potential.

So the first specific need that I would mention would be some way of helping local people finance their own public water supplies. I would commend both to your thinking the idea of some type of insured loan, insured mortgage loan, some type of financial backstop, so to speak, so that these individuals, who can provide for themselves if given a little help, can be better able to get their loans on better terms and sell their bonds on better terms.

The next specific need is for research. I would commend this to your consideration very, very highly. We would look to the Federal Government particularly for help in this field.

First of all, in general, on the streams themselves, we need much more basic data on the streams of the State than we now have. We need to know how can we increase both the flow of water in the streams, particularly at times of low flow. How can we do this and how can we make better use of the water that already is there?

We think the Federal Government through its research could make a very vital contribution there.

Secondly, in the Great Lakes we have difficulty with plankton. Plankton is a little tiny microscopic plant. It gets into our municipal water supplies. It raises hob with taste and odor. It causes all kinds of difficulty. We particularly need some help as far as the Federal Government is concerned in research to help solve this problem that plagues some of our large cities, particularly in the Great Lakes area.

Another thing that we need is we need more research on the development of more effective and more economical municipal water and sewage treatment plants. There are——

The CHAIRMAN. Before you go any further, is the plankton you refer to a vegetable or——

Dr. HEUSTIS. It is a little, tiny vegetable. It is a plant, sir. It is a microscopic plant, an algae or a thing such as that; yes sir.

The CHAIRMAN. All right.

Dr. HEUSTIS. To continue, we need more research on how we can make our large municipal sewage treatment facilities more effective. There are manufacturers that have some new ideas. These things run into many, many hundreds of thousands of dollars.

As the responsibility of the State health commission, we are not prone to advise communities to spend hundreds of thousands of dollars for the untried, particularly when there is no other resource. So we need help in developing research that would get data to advise not only Michigan but other State health departments themselves that are in this same situation with regard to the larger municipal water and sewage treatment plant.

The CHAIRMAN. May I ask you a question?

Have the municipalities used up the available funds under the public law providing assistance in the building of local sewage disposal plants?

Dr. HEUSTIS. They have, sir. Mr. Adams can answer these in greater detail than I, but the funds are being used and are being used very well.

The CHAIRMAN. Has that program been of real benefit to the State of Michigan?

Dr. HEUSTIS. We think that it has, sir.

The CHAIRMAN. Is there evidence that there is actual demand that will be implemented if more funds were made available in that program?

Dr. HEUSTIS. I would defer on that question to Mr. Adams, who would speak for the water resources commission, sir.

The CHAIRMAN. Can you answer that for us?

Mr. ADAMS. Yes, sir. We think H.R. 3610 should be adopted and made the law of the land and implemented by appropriations just as rapidly as possible.

The CHAIRMAN. I mean, though, do you think the availability of funds annually should be increased?

Mr. ADAMS. Yes, sir.

The CHAIRMAN. Thank you very much.

Dr. HEUSTIS. To continue with the fourth specific need for reseach, the so-called small treatment plant or package plant—here we have the subdivision that has moved out 10 or 15 or 20 miles from the larger city. There is no intervening easy economical way to connect the two things up. We anticipate that growth will occur someday but it will be many years. The manufacturers are coming out with what they say are newer and more economical ways of treating the sewage than the conventional methods that are now applied. We have no way to evaluate some of these claims. The claims are pretty good. We in the State health department and other State health departments throughout the country certainly need some very basic research that would tell us whether these claims are as good as they say, whether there are real possibilities and would also help the manufacturers, the private industry, if the claims do have deficiencies, as to how these might be corrected.

One of the things which Mr. Adams alluded to is the matter of research for practical and effective waste disposal on boats, both the larger installations and the smaller pleasure craft. This is extremely important because more and more, both the larger boats and the smaller ones are being moored in Michigan not too far from our public beaches, and not too far from some of our municipal water supplies. So this again takes Federal leadership to provide research for these five things. In conclusion, Senator Kerr, I will state that in Michigan we in the health department and with the others working in this field are very proud of our achievements although we still recognizance our deficiencies.

We have an unbounded determination to keep our water wonderland. We have faith in local governments. We have faith that local governments will act intelligently once the problems are defined and once the solutions are made clear.

We need to develop some method of backstopping local finance so that local communities can finance their own systems under more favorable terms, and we need Federal research to help develop the tools which we need right today and for tomorrow.

I wish to thank you very much for the opportunity to appear with you and should, later in the day, questions of a technical or engineering nature arise, Mr. John Volt, who has been helping me this morning, the acting director of the engineering division, and Andrew Pierce, one of my associates, are here and will remain all day.

Thank you very much.

The CHAIRMAN. Thank you very much, Doctor, for what is a most informative discussion of a very important and probably increasingly acute matters.

Dr. HEUSTIS. Thank you, sir.

Senator HART. I understand that our director of conservation, Gerald Eddy, who is here, has a statement which, because of the time problem, he will be willing to submit for the record.

Jerry, are you here? I saw you a moment ago.

STATEMENT OF GERALD E. EDDY, DIRECTOR OF CONSERVATION, STATE OF MICHIGAN

Mr. EDDY. That is very agreeable, Senator.

Senator HART. Is that all right?

Mr. EDDY. Yes.

Senator HART. If you would submit it here we will include it in full in the record.

In the event of any footnote questions we may have, we will get in touch with you by mail.

(The information referred to follows:)

STATEMENT OF GERALD E. EDDY, DIRECTOR, MICHIGAN DEPARTMENT OF CONSERVATION

The Michigan Department of Conservation, of which I am director, operates under legislation which, among other duties, conveys statutory responsibility and authority to "protect and conserve the natural resources of the State of Michigan; to provide and develop facilities for outdoor recreation; and to foster and encourage the protecting and propagation of game and fish."

It is my purpose to urge consideration of recreation as a beneficial use of water equal in value to other, more generally recognized, beneficial uses.

In America recreation has become a necessity for the many, rather than a *luxury for the few. Never before in man's history have so many people en*joyed so much leisure time. Outdoor recreation is not merely a socially acceptable use of leisure time: it is beneficial to our physical and mental health.

Water is a strong magnet for the recreation seeker. This fact is supported by soaring outboard motor sales, which have climbed from 20,000 to 650,000 per year during the last 30 years, with well over 5 million in use today. According to recent estimates over 30 million people participate in recreational boating. *A comparable number engage in sport fishing. In the eight Great Lakes States* alone, fishing license sales have increased by an average of 101 percent during the last 10 years, a period during which national population increased by only 20 percent. It is well recognized that our rich fisheries and many species of wildlife, especially waterfowl, constitute a valuable recreational resource which depends for its very existence on maintenance of adequate supplies of pure water.

The tremendous spurt in recreational shoreline development in recent years, as witnessed by construction of summer cottages and year-round homes on or near water, shows the deep desire of our people to live within sight of water,

be it ocean, lake, or stream. State and national parks, commercial resorts, marinas, and similar facilities on our shorelines receive increasingly heavy use. The present value of nonurban Great Lakes shoreline in Michigan alone, including recreational developments, has been estimated as being between one-forth and one-third of a billion dollars.

Nor is present dollar investment alone a true measure of the value our people place on the recreational use of water. It must be borne in mind that recreation is a nonconsumptive use of water. The same cannot be said for many domestic, agricultural and industrial uses. I submit, however, that thinking people are willing to assume the higher costs that will be entailed by proper treatment of polluted effluents or by control of pollution at the source and that they will resist unnecessary diversion of water to consumptive uses when other, possibly more costly, alternatives exist, if by so doing they can insure perpetuation of water of a quality suitable for recreation.

Efforts to obtain resolution of such conflicts in favor of recreational water use are exemplified by recent actions involving the Michigan Department of Conservation:

1. An attempt by private interests to seize an important publicly owned waterfowl area for port development was repelled.

2. Still in litigation is this department's stand against a use involving diversion of Great Lakes frontage and adjacent lake bottom and water surface from recreational to private industrial development.

3. In a recent instance where Great Lakes frontage and adjacent water areas were needed for utility operations clearly in the public interest, special legislation was obtained permitting sale of the desired tract for a price sufficient to obtain comparable recreation frontage nearby.

4. The latest amendment to the Federal Conservation Coordination Act, Public Law 85–624, provides, in part, that:

"Except as hereinafter stated in subsection (h) of this section, whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and drainage, by any department or agency of the United States, or by any public or private agency under Federal permit, or license, such department or agency first shall consult with the U.S. Fish and Wildlife Service, Department of the Interior, and with the head of the agency exercising administration over the wildlife resources of the particular State wherein the impoundment, diversion, or other control facility is to be constructed, with a view to the conservation of wildlife resources by preventing loss of and damage to such resources as well as providing for the development and improvement thereof in connection with such water resource development."

This act, as amended, is currently undergoing test at both Sugar Island and Grassy-Mamajuda Islands in the Detroit River, where proposed dredging, diking, and filling would be highly prejudicial to wildlife.

Factfinding is badly needed to provide both citizens and Government with accurate estimates of future recreational needs. Recreational opportunity is never a surplus commodity. The need for such opportunity will grow with increases in population, leisure time, and disposable income.

In the past, agencies responsible for providing recreation facilities have been justified in assuming that their most strenuous efforts in acquiring and developing water areas and water frontage would still be inadequate to meet public demand. As competition for water becomes more intense, the need becomes more apparent for research aimed at identification of ratios between population growth and recreational demand; between recreational demand and water areas available for development; and between recreation and other legitimate uses of water in both natural and artificial basins.

Recreation, like other water uses, must look increasingly to better retention of precipitation and runoff, both through new surface storage facilities and through improvements in ground water recharge. Michigan, with 52 percent of its land area in nonfarm use, is keenly aware of the role of properly managed forests, both publicly and privately owned, in water conservation; half of our precipitation falls on such lands. Better understanding of the value of various types of forest management to water conservation is earnestly needed. Michigan has undertaken research into this problem, some of it in cooperation with the U.S. Forest Service. Early results indicate that the extent of such Federal cooperation might be increased with profit.

Questions of fundamental importance, such as how much water area is needed for recreation in the next 20, 25, or 50 years, where it is needed, how fast it should be acquired and developed, and how much financial investment would be warranted, cannot be answered with confidence today. It is imperative that prompt effort be made to obtain the facts necessary to answer these questions.

Factfinding of the type suggested is the proper function of the States, so far as inland waters are concerned. However, attention of Federal agencies to these problems on the Great Lakes and other interstate waters, both by existing agency research organizations and through grants to academic organizations such as the Great Lakes Research Council, is urgently needed if future planning is to have a sound foundation.

Our national wealth has been built from rapid and often heedless exploitation of our natural resources. Through research, we are learning that often it is possible to have our cake and eat it, too. By continued research, and by refusal to accept the first and easiest methods of resource exploitation, multiple use may be made of a resource with little, if any, damage to individual interests.

Today we pride ourselves on having achieved, for all our people, the highest standard of living the world has ever known. The money we make means little unless it will buy us the things we want. There is no doubt that recreation in, on, and near water is one of the things we want. It is imperative, at this stage in our national development, for us to recognize that recreation is as important a use of water as any other use. If we fail in such recognition, our standard of living must decline.

Senator HART. I understand also that Keith Wilson, director of the Michigan State Waterways Commission, has a statement which we can receive. Is that right, Keith?

STATEMENT OF KEITH WILSON, DIRECTOR, MICHIGAN STATE WATERWAYS COMMISSION

Mr. WILSON. Yes, sir.

Senator HART. Thank you very much.

If you will submit that statement it will be printed in full in the record.

(The statement referred to follows:)

STATEMENT OF KEITH WILSON, DIRECTOR, MICHIGAN STATE WATERWAYS COMMISSION

The Michigan State Waterways Commission is legally vested with the responsibility for constructing, maintaining, and developing recreational and commercial navigational facilities in this State. These responsibilties are closely coordinated with similar responsibilites delegated by Congress to the U.S. Army Corps of Engineers, insofar as navigational facilities are concerned. As a matter of fact, our agency was specifically created for this purpose and only recently in its short history has a State program been developed independently of the Federal program.

It is our belief that there has been a substantial change in the character of navigation needs over the past 10 years caused by the tremendous growth of pleasure boating. The national recreational boating fleet has increased its numbers to over 5 million watercraft in 10 years, while it took the automobile industry in its infancy 20 years to accomplish the same growth. The economic impact of the growth of recreational boating has been substantial and it is estimated that more than $2 billion was spent on recreational boating and related services in 1958, and this figure is certain to be substantially greater this year.

Despite this rapid growth, the needs of recreational boating are not given recognition by the Federal Government commensurate with their national importance. This is particularly so in the case of public works programs calling for the construction of new recreational harbors as well as the maintenance of former commercial harbors now substantially used by small craft.

NEW FACILITIES

The present program

In 1945, Congress authorized the construction of 15 recreational harbors of refuge on the Great Lakes shoreline of Michigan. These harbors were recommended after an exhaustive study of the capabilities of recreational craft and after a careful analysis of existing ports and refuge sites in Michigan, and their authorization by Congress recognized the fact that recreational watercraft needed refuge havens at approximately 30-mile intervals if they were to be able to safely cruise on the Great Lakes; 11 of these harbors have been completed, 1 is scheduled for construction in the current fiscal year, and 2 projects have been allocated planning funds.

In 1945, when these projects were authorized, there was a total of 16,624 recreational and commercial fishing craft registered in the entire Great Lakes area, while today Michigan alone has an estimated 500,000 recreational craft in operation on its waters. In spite of this tremendous increase in our recreational boating fleet, Congress has not as yet seen fit to complete this network of refuge harbors and, perhaps even more important, has not authorized any additional recreational harbors in Michigan of any nature whatsoever.

It appears to this agency that the basic reason these projects have not been completed is that they are forced to compete with commercial harbors for appropriations on an unfair basis.

Appropriations for recreational harbors are difficult to obtain from Congress because of the low cost-benefit ratio figure they are assigned in comparison with commercial harbors. The cost-benefit ratio of a harbor is derived from a comparison of the savings realized by local interests in transportation costs as a result of the construction and maintenance of a navigational facility. If the benefits derived exceed the costs to the Federal Government of constructing and maintaining the harbor, the project is considered worthy of authorization and construction. Naturally, in competing with other projects for appropriations, the greater the benefit figure, the more likely the appropriation.

In the case of recreational harbors, it is almost impossible to derive a favorable benefit figure because the safety factor, which is probably the most significant reason the harbor is needed, is not capable of mathematical analysis. It is not a very difficult matter for the Corps of Engineers to determine the amount of tonnage carried into or out of a particular commercial harbor and to analyze the transportation savings realized through the use of water transportation. This figure, when compared with the cost of construction and/or maintaining a harbor, can easily produce a ratio of the cost of the harbor to the Federal Government as compared with the savings realized by local interests by virtue of the availability of the harbor.

When attempts are made to analyze the recreational traffic in the same manner, a great deal of difficulty is encountered because of the total dissimilarity of commercial and recreation craft. First of all, recreation traffic cannot be measured in tonnage figures because this type of craft does not carry freight. In this regard, getting there is not only half of the fun, it is the sole purpose of the trip.

Secondly, recreational traffic does not compete with any other form of transportation as such, so there is no basis upon which savings of this nature can be determined. Frankly, recreational watercraft can be very expensive to own, operate, and maintain, and it is doubtful that any boatowner has a boat because it is a cheaper mode of travel than, say, an automobile.

Finally, there is the fact that recreational harbors are needed primarily to provide a greater degree of safety to this form of recreation. Commercial vessels can travel very long distances with comparatively small risk, but recreational craft are much more susceptible to changes in the weather and must always be within a reasonable distance of protected facilities to be able to travel in comparative safety.

We sincerely believe that the growth of our recreational boating fleet has been greatly stimulated by the construction of the 11 refuge harbors by the Federal Government and this agency, and that this boating fleet has brought substantial revenues into our economy. The benefits are there, but they are just not being measured properly.

The new program

When the studies were being conducted in the thirties for the 15 harbors authorized by Congress in 1945, our recreational boating fleet consisted primarily of either very small or very large craft. As a result, the needs of only

the larger craft were considered, since very few of the smaller craft were capable of sustained cruising on the Great Lakes. This resulted in the proposed 30-mile network of harbors around the shores of the Great Lakes which was based entirely upon the needs of the recreational fleet as it then existed.

The present recreational fleet has changed substantially from that of the thirties in that there are much fewer large vessels and a far greater number of smaller craft capable of cruising on the Great Lakes. With the continued expansion of credit companies willing to finance the purchase of recreational craft, and with industry design changes making smaller craft cheaper to purchase initially, the greatest growth in recreational boating has been in craft 18 to 30 feet in length. With as little as $400 down and with payments spread over periods of 2 to 5 years, an individual can purchase a 25-foot craft, sleeping three to five individuals, and providing every reasonable convenience necessary for sustained cruises. Although these craft are safe within their limitations, they are operated by individuals with little or no previous boating experience on waters characterized by their sudden changes from calm, quiet lakes to rough, violent seas. Further, most of these smaller craft have but a single engine and the loss of power means that they are helpless and totally at the mercy of the weather.

It is because of this significant change in our boating population that this agency has considered the necessity for a change in our previous 30-mile harbor network to a lesser distance, especially in areas near large population centers. It is now our belief that auxiliary refuge harbors should be constructed at 15-mile intervals, especially in and around the Detroit area, to adequately provide for the safety of these smaller craft and their occupants. Construction of these harbors would mean that no boatmen would ever be more than 7½ miles from a haven of safety in case of sudden storm or mechanical difficulty. These harbors would also permit greater use of the Great Lakes by outboard craft, thereby relieving the ever-increasing congestion on our inland lakes. These harbors should be authorized and constructed on the same basis as previously authorized recreational harbors with the Federal Government and local interests sharing equally in the cost of construction of the necessary facilities.

The authorization of these projects and their eventual construction will once again revolve entirely upon the nature of the cost-benefit ratio figures derived, and it is therefore doubly important to us that this formula be revamped as quickly as possible to reflect the true value of such harbors.

EXISTING FACILITIES

We are growing increasingly concerned over the deterioration of many of the Federal Government's commercial harbors in Michigan. This deterioration has been permitted to occur because of the policy of the Bureau of the Budget toward appropriations for deferred maintenance projects.

A deferred maintenance project is the equivalent of a new start on a previously authorized and completed project, since it generally involves the substantial replacement of at least a portion of the original structure. The Bureau of the Budget has followed a policy of not recommending funds for the rehabilitation of existing navigational facilities until they are in danger of collapse or have completely failed. Although we consider it desirable to obtain the maximum use of every structure placed in the waters of this State, we do not believe it desirable or advisable to permit the structures to actually collapse before beginning to consider their repair or replacement.

Virtually all of the projects in need of deferred maintenance funds in Michigan are located on Lake Michigan and were constructed sometime prior to 1890. It is estimated that there is a backlog of deferred maintenance projects in Michigan in excess of $8 million and that this figure will continue to grow each year.

The nature of these marine structures is such that annual, minor repairs are rarely required or possible, and a breakwater or revetment might last 100 years without any repair work whatsoever. However, when repairs are needed, they are generally so extensive as to virtually require the replacement of the entire structure. This makes the immediate cash outlay for the project much greater than would have been required on an annual basis, but the average annual cost is still far less than would have had to be appropriated each year. This is caused by the fact that all repairs can be completed at once without the necessity of several different contractors transporting equipment and materials to the site over a period of years. Therefore, in considering the cost of deferred mainte-

nance on individual projects, we believe a much truer picture of the cost of the project to the Federal Government can be obtained by dividing the necessary appropriation by the number of years which have passed since any maintenance work has been accomplished. We believe you will find in each instance that the annual average is very low.

We believe that an annual program should be instituted by Congress to provide the Corps of Engineers with a specific sum to be used solely for the rehabilitation and maintenance of projects classified as deferred maintenance in nature. The present policy of the Bureau of the Budget is such that rarely are deferred maintenance appropriations recommended until the project has actually failed or collapsed. This policy is penny wise and pound foolish, since the collapse of a marine structure can well render the harbor useless until necessary repairs are made. This means that considerable overtime labor is required of the Corps of Engineers as well as the contractor on the job, thereby greatly increasing the cost of the repairs. If these projects were provided for each year by an appropriation in the regular budget, the needed repairs could be completed on an orderly, routine basis, at a considerable savings to the Federal Government.

We previously indicated that more than $8 million in deferred maintenance funds are presently required in Michigan to take care of the tremendous backlog allowed to develop by the Bureau of the Budget. We therefore propose that the Appropriations Committees of Congress, the Bureau of the Budget, and the Chief of Army Engineers be asked to formulate a policy whereby an annual appropriation can be made to permit the accomplishment of repairs to deferred maintenance projects on an annual basis. It is our opinion that an annual appropriation of approximately $3 million would be required for Michigan for at least the next 3 years, and that thereafter this appropriation could be reduced by 50 percent and still permit the adequate maintenance of existing navigational facilities in this State.

In summary, we believe that the tremendous increase in recreational boating should be recognized by Congress and the executive agencies involved in the construction and maintenance of navigational facilities through the adoption of a cost-benefit formula more appropriate to the times than the formula presently being used. We further believe that a reevaluation of the present 30-mile harbor network interval should be made with a view toward reducing this interval to 15 miles near large population centers. We believe that a congressional policy of providing annual deferred maintenance appropriations to the Corps of Engineers should be instituted, so that the tremendous investment already made in navigational facilities can be preserved at the lowest possible cost.

Senator HART. Because later in the day Senator Kerr must leave us, I am attempting to insure that our hospitality is full enough to include his hearing our visitors from Indiana, Wisconsin and Ohio.

If Mr. Frost of the Ohio Water Resource Department is here now, we would be glad to hear him.

We would be glad to hear you, sir.

STATEMENT OF S. L. FROST, WATER DIVISION, OHIO DEPARTMENT OF NATURAL RESOURCES

Mr. FROST. Senator Kerr and Senator Hart. I bring greetings from Ohio. I find today that I perhaps have to substitute and act as a farmer, an expert on municipal water, a superintendent and a water resource engineer and some kind of a flood control expert and perhaps I should preface this by a little story that one of my friends in Texas told me once about his water problem reminding him of the farmer who was seen rowing across the flooded street in his town to collect his drought disaster check. In other words, our water problem is one of too much and too little and having it at the right place and the right time.

In Ohio, our water resource and problem stacks up something like this.

We rank second in manufacturing value added in manufacturing. Our industrial water use is first in the Nation. We rank fifth in population and fourth in the use of public water supplies. Our land area is 36th among the States. The land area on which water can be obtained is relatively small for the population and industry which must be served. Water withdrawn for use is 46 percent of the volume of runoff originating on the land surface of the State. Only New Jersey exceeds this percentage among the nonirrigation States.

We use presently about 12 billion gallons of water a day. We estimate by 1975 that this will have grown to at least, and conservatively, 16 billion gallons daily and close to 25 billion gallons a day by the year 2000.

We feel that Ohio would have a very precarious situation in meeting its water needs without the waters of Lake Erie for use in the northern third of the State and without the Ohio River along the southern portion of our boundary.

We have figured out that in terms of our population and the tremendous pressure for more flood control, water supply and recreation lakes in the State that at present we have 91 people per acre of water in Ohio, by 1985 without any further development we will have 145 people per acre of water.

The CHAIRMAN. Ninety-one people per acre now?

Mr. FROST. Yes, sir. By 1985, 145.

I will give you a little chart on this. We face this future with the highest per capita reservoir pressure in the United States. Only six States have less impounded water area. I mentioned that we have 91 people per acre of water in Ohio. The U.S. average is 5.4 people. We have about 100,000 acres of impounded water as compared to an average of 634,000 in the other States.

The CHAIRMAN. What is your average annual rainfall?

Mr. FROST. 38 inches, sir.

About two-thirds of that is evaporated and transpired, leaving about 12 to 13 inches for our normal use.

The CHAIRMAN. I would like to have you explain what you mean by per capita reservoir pressure.

Mr. FROST. That, sir, is our total population in the State divided into the area of water, of impounded water.

This pressure is reflected not only in use of water for supplies but also in recreation. That is our recreation water uses.

Turning just very briefly from the problem of supply and use is the other problem of too much water. Earlier this year Ohio suffered $100 million in damage from floods. It has been estimated that over a half billion dollars would be needed to be spent for flood-control improvements to reduce this damage two-thirds.

In view of this, it is our feeling that first there is a need for extensive surveys of our resources, our water resources, and the problems connected with them in terms of water supply and flood control where additional supplies can be obtained from and then some practical plan for accomplishing these objectives.

I will just skip briefly here to a review of a study we made as part of this survey in Ohio. We contacted the municipalities, some 625 of them, that have public water supply systems and to determine the nature of their water problem we wanted to know whether it was

actually a scarcity of raw water supply or what were the factors. Invariably and, No. 1, for the problem was the problem of finances.

The growth of municipalities, the requirements for other public services, make this problem of financing water improvements one of the big headaches in the State.

This is perhaps indicated by the growth in the number of municipal water supply systems. We have had 172 in 1900 compared to 625 today. We think that possibly one of the answers may lie in future supply systems but more wide-scale regional watershed developments to manage and develop our water resources at lower costs and to provide wholesale water for larger and more user areas.

Then the municipalities can check these sources, treat it and distribute it where needed.

Another problem in our growth is the matter of reservoir sites. The growth in population and building of new roads and other improvements have reduced the number of low-cost reservoir sites. The cost of acquiring land and moving improvements is representing a higher and higher proportion of the total project costs.

In many cases a desirable site has been completely lost because of the costly improvements on it. It may be feasible to start early acquisition of future water storage sites just as we have established National and State forests on which to grow future supplies of timber.

Another factor in this problem of water in Ohio, as we visualize it, is the unwise use of flood plains, the unrestricted building on our flood plains also needs to be critically examined.

The CHAIRMAN. I would like for you to explain that a little bit.

Mr. FROST. By nature our towns and cities, our industries had filled up along courses of water. A river system is not alone the area between the banks of the river but what we call the flood plain or the area over which the river must flow.

The CHAIRMAN. In floodtimes?

Mr. FROST. In floodtimes. This is as much as part of the river system as the channel itself during which the river normally flows.

However, this is the part that we only see occasionally during rare floods. Yet our building developers are all not aware of the boundaries of flood zones and have built up on them, and such has happened during the course of years from 1913 when we had a very severe flood in the State until this last year of 1959. We found many areas in the State which thought that they were safe even behind existing flood control improvements which were flooded during January of this year, because the type of project at the time, its feasibility and its control, was determined for a nonexistent metropolitan development that has come in the year since the original building.

The CHAIRMAN. What rivers principally were the areas of damage that you refer to?

Mr. FROST. We had the Miami River Basin, the Muskingum River Basin, the Mahoning River Basin in Youngstown area, the Scioto River Basin in which Columbus, the capital, is located, and then the northwest part of the State escaped the January storm as if by irony we had floods in February which hit northwest Ohio. So between the two storms the State was pretty well soused earlier this year.

I might show you this problem of what we call flood plains. This is the report we made on the Cuyahoga and Chagrin River Basin. The red area——

The CHAIRMAN. Is that Cleveland?

Mr. FROST. This is Cleveland and this is Akron coming down the valley on this side. The red area is what was inundated. Earlier, this area had been studied for flood control and no improvements were found feasible. That was 20 years ago. In the meantime this area built up. These metropolitan developments spread up the valley. There were large losses in this area in January.

Now, the question is, can flood control be justified? In the meantime, many of the reservoir sites have been lost which could have been used, so we think that much more consideration needs to be given to a plan of possibly zoning some of these flood plains, possibly acquiring some of the lands and putting it into parks or less hazardous uses.

Now, I would like to review very briefly some suggestions and ideas that we have thought up and we would like to present them for the consideration of the committee.

In the look ahead we feel that, first, the States themselves must assume much greater leadership in this program of water resource management. Each State has a tremendous opportunity to exert a new and dynamic leadership in formulating water resource policy for its own citizens. This policy needs to be supported with money and by aggressive programs of research, planning, and development. If need be, the States can even assist to the extent of creating watershed districts by State law, and providing assistance in managing them. This would help to answer some of the problems of water diversion that will ultimately arise.

State water resource activity, with but few exceptions, has been a weak sister compared to other State natural resource conservation effort. Expenditures reported to the Council of State Governments in 1954–55 fiscal year, exclusive of pollution control and wildlife developments, totaled, totaled only some $24 million.

Second is the possibility of Federal aid by cooperative financing. Greater Federal participation, with particular consideration to studying the feasibility and means of cooperative financial assistance with the States on programs of water development and pollution abatement. Such a program might be similar to the patterns of cooperative Federal-State highway construction forest fire control. Such financial participation should be on a matching basis as a stimulus and incentive to State participation.

Third is citizen education, and we feel the need for a nationwide program of citizen education and their participation in water resource programs. Broadly conceived, such effort, while working at all levels of government, should stress local effort. An enlightened public, with inspired leadership, can be the greatest force around which to marshal a frontal attack on every phase of water resource development that we can envision.

Fourth, the need for training more water resource leaders. A broadened program in our colleges and universities of training water resource management engineers.

Next, the consideration of a national water congress.

It might be called by the President, with the Governors, and their staffs, and selected individuals to draft in open meeting a program of water conservation for the United States. The similarity between the idea of a proposed water congress and the American Forestry Congress of 1908 will be readily recognizable.

And then, in particular, specific features of these suggestions are, sixth, the idea of reservoir site acquisition.

More reservoir site planning needs to be implemented. Then a means devised to acquire desirable sites far ahead of actual need. Wherever possible they should be for multiple-purpose uses for water supply, flood control, and recreation.

The next is flood plain zoning. Attention likewise needs to be given to adopting legislation to control flood plain development through adequate zoning or acquisition of lands adjacent to critical river systems. Such lands could be used for parks. This program could be conducted by States and local governments with Federal cooperation coming from grants of the urban renewal administration.

And lastly, surveys and data collection, which includes acceleration of State-Federal cooperative programs on mapping and collection and interpretation of basic hydrologic data is needed.

There is one additional point I would like to throw in that has come out of our studies on water use in Ohio, which offers quite a number of hopes, and that is the question of net consumption of water.

In this study that we made in the Cuyahoga-Chagrine area, opposite page 39 on that report, we found that this area used close to 1.7 billion gallons of water a day—1.6 billion gallons of that water got back to the streams and lakes from which it was taken, meaning a net consumption of only about 35 percent.

The tremendous quantity of water that has returned from this use implies the importance of pollution abatement and treatment of this waste water. We therefore think that pollution abatement, the treatment of waste water, is as important a part of water conservation as developing new supplies.

I just wanted to add that one other point that I had not perhaps touched on.

I think that concludes our remarks, Senator Kerr and Senator Hart.

We appreciate the opportunity.

Senator HART. Thank you very much, Mr. Frost.

Mr. FROST. Yes, sir.

Mr. Chairman, we would like to have our prepared statement become a part of the record.

Senator HART. Without objection, the statement will be incorporated in the record.

(The statement referred to follows:)

STATEMENT OF S. L. FROST, ASSISTANT CHIEF, WATER DIVISION, DEPARTMENT OF NATURAL RESOURCES

Governor DiSalle has previously presented to Senator Kerr a statement of "Ohio's Water Resources, Plans, Programs, and Problems." We would like to review some of the special parts of this report, and add to it.

Water use by industry first

Ohio ranks second in the Nation in value added by manufacturing but ranks first in the industrial use of fresh water. It ranks fifth in population and fourth in the use of water for public water supplies. In land area Ohio ranks 36th in size among the States. The land area on which water can be obtained is relatively small for the population and industry which must be served. Water withdrawn for use is 46 percent of the volume of runoff originating on the land surface of the State. Only New Jersey exceeds this percentage among the nonirrigation States.

Ohio would have a precarious situation in meeting its water needs without the waters of Lake Erie for use by the northern third of the State within the Lake Erie Basin and the Ohio River on the south.

$100 million flood damage

Earlier this year Ohio suffered $100 million in flood damages. It is estimated that over half a billion dollars would need to be spent for flood control improvements to reduce this damage two-thirds.

Surveys and plans needed

This situation points up the need for an extensive survey of our existing water resources; a determination of where additional supplies can be obtained and how floods can be controlled; and then a practical plan to accomplish these objectives.

Watersheds divide our supply

Through the ages of time, nature has etched out the courses of streams and rivers. Each tiny tributary, each stream, each river has its own catchment basin, or watershed. Our watersheds thus divide our supplies of rainfall. Depending on their size, their topography, their geology, temperature, land use, and types and conditions of their soils at the time it rains, each watershed has a water delivery character of its own. By continually gaging and studying the record of streamflow we can gradually determine just what the ranges of streamflow can be within the limits of rain delivered to it.

Every water improvement we make, whether for water supply, flood control, drainage, power, navigation, recreation, or pollution abatement, is determined by the water delivery character of its watershed area. Try as we will, we can't escape this truth. Our watersheds thus become the all-important link between rainfall from the heavens and mankind's use and control of water.

Dilemma of political subdivisions

How unfortunate that we have fractured that link by such simple, unassuming devices as lines on a map called political subdivisions. But those political boundaries stand today as one of the great problems of effectively finding a way out of our increasing water dilemma. Here we find man fighting against himself. Dependent on effective watershed control, we have surrounded ourselves with so many political barriers that we find ourselves in a continual struggle to break through a vastly complicated web.

Realistically, we can't go back to the utopia of erasing our political boundaries. So how do we do the next best thing, which is to live with the mess we have created?

Costs are big factor

Here in Ohio we have been working for 3 years on a water plan inventory. We have found that water supply is becoming an increasingly difficult problem—not because water is scarce, but because of the rising costs of securing it and, after using it, of adequately treating it before returning it to our streams and lakes. Finances are the No. 1 headache. Unless we are smart enough to lower these cost barriers, we can visualize some rough times ahead.

Ohio's municipal systems almost quadrupled

One thing contributing to this dilemma in Ohio is the growth in municipal water supply systems—from 172 in 1900 to 625 today. We think one answer is fewer supply systems, but more wide-scale regional watershed developments efficiently managed to lower costs and to provide wholesale water to more user areas. These same developments would handle the problem of sewers.

We likewise visualize the need for a system of reserving reservoir sites while they are still available, more pipeline developments, and eventually more diversion of water between watersheds.

Our studies of water use have shown a net consumption of only 10 percent of daily water withdrawals of over 12 billion gallons daily. This means that tremendous quantities are being returned after use. Therefore, pollution abatement is as important a part of water conservation as building new supply sources. Thereby we could reuse water many times.

Reservoir sites disappearing

The growth in population and the building of new roads and other improvements have also reduced the number of low-cost reservoir sites. The cost of acquiring land and of moving improvements is representing a higher and higher proportion of the total project cost. In many cases a desirable site has been completely lost because of the costly improvements on it. It may be feasible to start early acquisition of sites for future water storage just as we have established national and State forests on which to grow future supplies of timber.

Unwise use of flood plains

The unrestricted building on our flood plains also needs to be critically examined. One authority has estimated that for every $6 spent for flood control, $5 is spent on new building on the flood plain. At this rate we will never catch up.

A newer, more modern line of thinking suggests that more attention be given to controlling the development of flood plains. In critical areas, lands may be zoned or purchased and put into uses, such as parks, with low flood risk damages.

We have also found in Ohio something like 48 agencies assigned by law with some kind of water authority, not to mention our 625 municipal water agencies. There's an old saying that what is everybody's business is nobody's business. Where, then, do we go from here?

SOME POSSIBLE PROGRAMS

States must assume more leadership

1. A direct assault, and that is by the States themselves. Each State has a tremendous opportunity to exert a new and dynamic leadership in formulating water resource policy for its own citizens. This policy needs to be supported with money and by aggressive programs of research, planning, and development. If need be, the States can even assist to the extent of creating watershed districts by State law, and providing assistance in managing them. This would help to answer some of the problems of water diversion that will ultimately arise.

State water resource activity, with but few exceptions, has been a weak sister compared to other State natural resource conservation effort. Expenditures reported to the Council of State Governments in 1954–55 fiscal year, exclusive of pollution control and wildlife developments, totaled only some $24 million. Only a few States have ventured into the field of water development—an activity generally left to the Federal or local governments.

Federal aid by cooperative financing

2. Greater Federal participation, with particular consideration to studying the feasibility and means of cooperative financial assistance with the States on programs of water development and pollution abatement. Such a program might be similar to the patterns of cooperative Federal-State highway construction and forest fire control. Such financial participation should be on a matching basis as a stimulus and incentive to State participation.

Citizen education

3. A nationwide program of citizen education and their participation in water resource programs. Broadly conceived, such effort, while working at all levels of government, should stress local effort. An enlightened public, with inspired leadership, can be the greatest force around which to marshal a frontal attack on every phase of water resource development that we can envision.

Training more water resource leaders

4. A broadened program in our colleges and universities of training water resource management engineers.

National water congress

5. A national water congress to be called by the President, with the Governors, their staffs, and selected individuals to draft in open meeting a program of water conservation for the United States. The similarity between the idea

of a proposed water congress and the American Forestry Congress of 1908 will be readily recognizable.

Reservoir site acquisition

6. Reservoir site planning needs to be implemented. Then a means devised to acquire desirable sites far ahead of actual need. Wherever possible they should be for multiple-purpose uses for water supply, flood control and recreation.

Flood plain zoning.

7. Attention likewise needs to be given to adopting legislation to control flood plain development through adequate zoning or acquisition of lands adjacent to critical river systems. Such lands could be used for parks. This program could be conducted by States and local governments with Federal cooperation coming from grants of the urban renewal administration.

Surveys and data collection

8. Acceleration of State-Federal cooperative programs on mapping and collection and interpretation of basic hydrologic data is needed.

Mr. FROST. I have also a further statement of the Ohio Department of Natural Resources which I would like to furnish for the committee.

Senator HART. Without objection, the statement of Mr. A. F. Wakefield, chairman, Ohio Waterways Safety Commission, will be included in the record at the conclusion of Mr. Frost's statement.

(The information referred to follows:)

OHIO DEPARTMENT OF NATURAL RESOURCES,
Vermilion, Ohio, October 28, 1959.

U.S. SENATE SELECT COMMITTEE ON NATURAL WATER RESOURCES,
Courtesy, S. L. Frost, Assistant Chief, Ohio Division of Water,
Care of Statler-Hilton Hotel, Detroit, Mich.

GENTLEMEN: Purpose (a) of your committee prompts me to write, as chairman of the Waterways Safety Commission of the State of Ohio, viz:

"(a) * * * extent of water resources * * * to satisfy the water-use requirements of population * * * of recreational * * * value.

"(b) the character of legislation * * * for increasing the usefulness of available resources * * *."

On March 2, 1945, during the 79th Congress, Public Law 14 was approved and became known as the Rivers and Harbors Act of 1945.

This act had for its purpose the authorization of construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes.

On page 11 and following pages of this law, it should be noted that among its provisions are "Coasts of the Great Lakes; harbors of refuge for light-draft vessels," and in this section are included: Ottawa River Cooley Creek, Turtle Creek, Port Clinton, East Harbor, Put-in-Bay, Hummel Pond, Sandusky, Huron, Avon Lake, Lorain, Rocky River, Chagrin River, Mentor, Fairport, Arcola Creek, Ashtabula, and Conneaut.

Further, on page 25, is a section devoted to "The coast of Lake Erie, with a view to establishments of harbors of refuge for light-draft vessels for commercial and/or recreational purposes."

Since a preliminary examination and survey of the shores of Lake Erie was authorized by this act, a preliminary report was prepared. The Chief of Engineers, on December 20, 1946, approved preparation of a detailed survey report, which was to include study of 33 specific locations on Lake Erie. This comprehensive report covers portions of Michigan, Pennsylvania, and New York, as well as Ohio. Twenty-one specific localities in Ohio were to be included.

Funds for the survey report were first appropriated in fiscal year 1949, and field surveys initiated in the fall of 1948, and continued until the spring of 1951, when funds were exhausted.

The advent of the Korean conflict stopped all public work appropriations, as you know. Since that time no funds have been available to complete the work on this survey.

In July 1958, I was advised through reliable sources that $280,000 was needed to complete this comprehensive study, and that it would require about 3 years for completion, with the necessary funds divided between the 3 years.

On March 10, 1959, General Person, of the U.S. Corps of Engineers, advised that a preliminary examination was completed in 1948, in response to the authority, at an estimated cost of $31,800. Since that time funds in the amounts of $23,000, $34,000, $10,300, and $500 were expended on the survey for fiscal years 1949, 1950, 1951, and 1952, respectively. The revised cost of the study is now estimated to be $40,000, of which about $100,000 has been appropriated.

Later we learned through the Washington office of the Corps of Engineers that without reference to their overall program, overall capability, or fiscal considerations, an amount of $60,000 could be utilized for this study in fiscal year 1960, for the survey of the south shore of Lake Erie in the interest of harbors of refuge for small craft.

In authorizing the construction of recreational harbors-of-refuge, Congress has followed an established policy that generally the harbor should be constructed with funds provided equally by the United States and non-Federal interests. This cost division is limited to the first cost of the navigational facilities, which comprise the protective structures for the harbors and dredging of the entrance channel and anchorage area within the harbor basis. Besides being required to participate equally in the cost of such navigational facilities, local interests must also furnish certain other items of cooperation.

Due to the establishment of an Ohio Waterway Safety Commission, and to the fact that presently there is $288,930 in the hands of the commission, which represents funds derived from rebates under the gas tax users of boats, we recommend to your committee the completion of the survey of the south shore of Lake Erie. We feel that this will allow the commission to make wise determinations, in cooperation with the Federal Government, as provided for in section 1507.064 of the revised code regarding cooperation with the Corps of Engineers, under Public Law 14 of the 79th Congress.

In view of the fact that this survey was approved back as far as 1945, and $67,800 has already been expended, coupled with the fact that the State of Ohio is prepared through the aforementioned commission to furnish funds to help carry out improvements projects, we urge that this committee include the necessary $200,000 in their recommendations, so the survey may be carried to completion.

The adoption of this plan will allow the commission to arrive at its objective making the 5 million acres of recreational water in Lake Erie available to the millions of people in the State of Ohio in 1980.

Sincerely yours,

A. F. WAKEFIELD,
Chairman, Ohio Waterways Safety Commission.

Senator HART. We also have statements submitted for the record by the following: Lake Carriers' Association, Great Lakes Harbors Commission, Thomas F. Barton, professor of geography, Indiana University.

(The statements referred to follow:)

LAKE CARRIERS' ASSOCIATION,
Cleveland, Ohio, October 20, 1959.

Hon. PHILIP A. HART,
U.S. Senate, Washington, D.C.

DEAR SENATOR HART: Your letter of September 29, 1959, advising of the hearing to be held in Detroit, Mich., on October 29, concerning the future development of our national water resources, is much appreciated. Your observation that the future requirements of the northeastern-north central region will be far greater and in many ways more difficult to fulfill than many of the Western States is indeed all too true, a matter which is of no little concern to the Great Lakes vessel industry.

As the need for water increases with the growth of population and industry, there appears to be a tendency to look to the Great Lakes as one source of unending water supply. The perpetual efforts of the State of Illinois and the Sanitary District of Chicago to increase the diversion of water from the Great Lakes through the Illinois Waterway are but one example. These efforts have

gained the support of many areas throughout the Mississippi River Valley and communities as far away as New Orleans.

Because of the continued pressure to tap the Great Lakes for all manner of purposes, it would seem appropriate to lay before the select committee certain facts regarding those waters. The eight States and two Provinces bordering the Great Lakes hold title to those waters under a high public trust to protect and preserve them for the use and benefit of their citizens. Under the law common to the United States and Canada, any diversion of water from the Great Lakes watershed by a riparian owner or other user constitutes a wrong against all other riparian owners. Diversions lower the natural level of the lakes, their connecting and tributary waters and the St. Lawrence River, directly impair natural water depths and nullify costly improvements therein. In turn, these results materially reduce the carrying capacity of United States and Canadian Great Lakes vessels and increase transportation costs to the detriment and injury of all the people.

From time to time, the waters of the Great Lakes have been made the subject of various treaties between the United States and Canada, culminating in the Boundary Waters Treaty of 1909. By this treaty, the waters of the Great Lakes have been declared international and dedicated to the primary purposes of commerce and navigation for the benefit and enjoyment of the inhabitants of the two countries. The last paragraph of article II of the Boundary Waters Treaty specifically reserves to each country the right to object to any interference with or diversions of waters on the other side of the boundary, the effect of which would be productive of material injury to the navigating interests on its own side of the boundary.

Consequently, in considering the water resources of the Great Lakes Basin, it becomes of paramount importance to preserve the integrity of the Great Lakes watershed. It should be added that the jurisdiction of the International Joint Commission, established under the Boundary Waters Treaty, must also be given careful attention, as many of the problems related to the use of Great Lakes waters properly fall within the purview of that body.

It is requested that these comments be made a part of the record of the hearings to be held at Detroit, Mich., on October 29, 1959.

Sincerely yours,

LYNDON SPENCER.

CHICAGO, ILL., *October 26, 1959.*

Hon. PHILIP A. HART,
U.S. Senate,
Select Committee on National Water Resources.

GENTLEMEN: The Great Lakes Harbors Association is a nonprofit association, organized in 1923, for the following objects and purposes, among others:

"1. * * *.

"2. To restore, preserve, and protect the waters of the Great Lakes at their normal levels.

"3. To encourage the furtherance of the waterway projects designed to connect the Great Lakes with the Atlantic Ocean and the Gulf of Mexico.

* * * * * * *

"9. * * * ."

The Great Lakes Harbors Association is deeply concerned at this time with the extent and character of the activities designed to increase the amount of water diverted permanently from the Great Lakes-St. Lawrence River watershed. The chief offender is the Metropolitan Sanitary District of Chicago, Ill., hereinafter referred to as the "Chicago Sanitary District."

The Chicago diversion of the waters of the Great Lakes-St. Lawrence River watershed dates back to the year 1900 when the Chicago Sanitary and Ship Canal was constructed and opened for the passage of water from Lake Michigan which was diverted from the Great Lakes-St. Lawrence River watershed to the Mississippi River watershed. The total amount of water diverted from the Great Lakes watershed, including direct diversion from Lake Michigan and the domestic pumpage of the city of Chicago, as measured at Lockport, Ill., was 2,900 cubic feet per second, in 1900. The amounts of water diverted through the sanitary district canal increased thereafter and reached a high of 10,000 cubic feet per second of water taken from Lake Michigan. Since the year 1938, the diversion through the Chicago Sanitary and Ship Canal has been at an average annual rate of 1,500 cubic feet per second exclusive of the Chicago domestic

pumpage, which averaged a total of about 1,800 cubic feet per second, resulting in a total diversion of about 3,300 cubic feet per second of water lost permanently to the Great Lakes-St. Lawrence River watershed. This diversion reduces the water supply to Lakes Michigan, Huron, Erie, and Ontario. A permanent diversion at Chicago of 1,000 cubic feet per second has the effect of lowering the levels of Lakes Michigan and Huron 1 inch, the levels of Lake Erie five-eighths inch, and Lake Ontario five-eights inch. Lake Superior is regulated and hence is not affected by the Chicago diversion insofar as lake levels are concerned. (See S. Doc. No. 28, 85th Cong., 1st sess., 1957.)

In suits brought by the States of Wisconsin, Minnesota, Michigan, Ohio, Pennsylvania, and New York to enjoin the Chicago Sanitary District and the State of Illinois from diverting the waters of the Great Lakes through the Chicago Drainage Canal to the Mississippi River watershed, the U.S. Supreme Court held that the lowering of the levels of the Great Lakes by reason of the Chicago diversion resulted in great losses to the complainant States and their citizens and their property owners (278 U.S. 367, at pp. 408–409 (1929)).

The diversions of water from Lake Michigan at Chicago initially were made for the purpose of diluting the sewage of the Chicago Sanitary District and transporting the sewage into the DesPlaines and Illinois Rivers and thence to the Mississippi River, thus preventing the contamination of the waters of Lake Michigan from which the city of Chicago obtains its domestic water supply. A decree of the U.S. Supreme Court, dated April 21, 1930 (281 U.S. 696) as amended in 1933, (289 U.S. 710) imposed on the State of Illinois the duty to take all necessary steps to construct and secure the completion of adequate sewage disposal plants and sewers for the disposition of the sewage of the Chicago Sanitary District through means other than lake diversion.

Since 1938 bills have been introduced at nearly every session of Congress to increase the amount of direct diversion at Chicago above the amount fixed by the 1930 decree of the Court. No such bill has been enacted into law, the President having vetoed in 1954 and 1956 diversion bills which were passed by Congress.

On June 29, 1959, the U.S. Supreme Court granted an amended application of the States of Wisconsin, Minnesota, Ohio, Pennsylvania, Michigan, and New York for a reopening and amendment of the decree of April 21, 1930. In these applications the lake States seek to require the Chicago Sanitary District and the State of Illinois to return to the Great Lakes Basin the effluent of the Chicago domestic pumpage which was taken from Lake Michigan. A special master, Hon. Albert B. Maris, senior U.S. circuit judge, of Philadelphia, was appointed by the U.S. Supreme Court to take testimony and to report to the Supreme Court his recommendations. The special master is also hearing in connection with the above-amended application of the lake States, the complaint of the State of Illinois for declaratory judgment and injunction on behalf of the Elmhurst-Villa Park-Lombard Water Commission which seeks to divert water from Lake Michigan for domestic and industrial purposes. The communities of Elmhurst, Villa Park, and Lombard are located west of Lake Michigan in the Mississippi River watershed.

Four communities, also located in the Mississippi River Basin, and located north of the Elmhurst-Villa Park-Lombard communities, also plan to divert water from Lake Michigan for domestic and industrial purposes. These four communities are DesPlaines, Arlington, Mount Prospect, and Palatine, Ill.

In addition to the above Illinois cities and villages which have indicated their intention to divert water from Lake Michigan, certain Wisconsin, Indiana, and Ohio communities have expressed a desire to divert water from the Great Lakes-St. Lawrence River watershed to another basin.

In August 1958, Maj. Gen. Emerson C. Itschner, Chief of the Corps of Engineers, U.S. Army, at a water conservation conference held at Chicago, stated that water is a limited resource now in the United States and that a stepped-up program of water conservation is needed to keep America strong (Chicago Sun-Times, and Chicago Tribune, Aug. 28, 1958). General Itschner estimated that in 17 years the demand for water would double. The Illinois Water Survey is in agreement that the use of water in the United States will be doubled in the next 17 years and every 17 years for a long time to come (Chicago Daily News, Oct. 10, 1958).

It is crystal clear that by the year 1980 the Great Lakes will be impaired, if not destroyed, if every community along the Great Lakes is permitted to divert the waters of the Great Lakes to another watershed. The Great Lakes con-

stitute the greatest inland waterway in the world, with freight rates on waterborne commerce that are astonishingly low. Many hundreds of millions of dollars have been spent on improving the navigable capacity of the Great Lakes and their connecting channels. The St. Lawrence Seaway and power project, a joint enterprise undertaken by the United States and Canada will have spent about $1 billion when the project is fully completed. Port development expenditures for the Great Lakes ports for the period from 1946 to 1957 totaled $147 million (World Ports magazine, August 1958, p. 27). The project depth for the seaway channels is 27 feet. Every diversion of water from the Great Lakes will lower the levels of these lakes and thus inflict substantial damage to the navigation, commercial, and other interests of the Great Lakes States.

As the then Secretary of War, Hon. Henry L. Stimson, well said in 1913, in denying an application of the Chicago Sanitary District for a permanent diversion of 10,000 cubic feet per second of water from Lake Michigan at Chicago:

"* * * Every drop of water taken out at Chicago necessarily tends to nullify costly improvements made under direct authority of Congress throughout the Great Lakes, and a withdrawal of the amount now applied for would nullify such expenditures to the amount of many millions of dollars, as well as inflict an even greater loss upon the navigation interests using such waters. * * *"

The St. Lawrence Seaway to be utilized to its full capacity requires that the Great Lakes be maintained at their natural levels. Every community or industry which takes water from the Great Lakes should be required to return such water, after use and treatment, to the Great Lakes. The tremendous increase in population in the Great Lakes area in the next 20 years will push the demand for water to unprecedented levels for domestic and industrial uses Now is the time to lay down some ground rules which will restore, preserve, and protect the waters of the Great Lakes at their normal levels. The Great Lakes do not constitute an inexhaustible supply of water and the natural advantages of the Great Lakes region should not be sacrificed to the alleged sanitation or power needs of Chicago or any other city or community that seeks to divert the waters of the Great Lakes-St. Lawrence River watershed.

Respectfully submitted.

GREAT LAKES HARBORS ASSOCIATION,
By HERBERT H. NAUJOKS,
President and Counsel.

INDIANA UNIVERSITY,
COLLEGE OF ARTS AND SCIENCES,
Bloomington, Ind., October 26, 1959.

Senator PHILIP HART,
Senate Office Building,
Washington, D.C.

DEAR HONORABLE SENATOR HART: If I am correctly informed, you are a member of the Senate Select Committee on National Water Resources which will hold a public hearing at Detroit, Mich., on October 29, 1959, for the purpose of assembling data on the Nation's water problems and of considering current and possible solutions to those problems. If possible, I would like this statement considered at the hearing.

I am a professor in the Department of Geography at Indiana University, and have long been interested in conservation, including water conservation. As a member of the Illinois Militia, I was called out on flood duty 2 years in succession.

It seems to me that too much emphasis has been placed on downstream improvements in water management, such as flood control reservoirs, levees for protection of lowlands subject to flooding, and reservoirs to impound water for municipal, industrial, and irrigation use.

Important as these measures are, this policy ignores the important fact that there cannot be full use of our water resources without more attention to the upstream watershed management phases. Shouldn't our basic policy be one of holding the water on the land where it falls? Basically, water management is closely allied with land use and land management practices. There are many current programs directed toward these phases of water management and these programs should receive full consideration in any national study of water resources and needs. I have in mind such programs as the small watersheds program of the Department of Agriculture under Public Law 566, and the soil

and water conserving practices promoted by the Soil Conservation Service and some ACP practices.

One such program which I have had occasion to study is the national forest program in this area, under which lands depleted under past management are acquired by the Federal Government and managed to (1) produce timber products, and (2) to improve conditions on the watershed and prevent excessive erosion and waterflow. A copy of my paper on that study, "The Hoosier National Forest," is attached.

The study shows that the program on the Hoosier National Forest, although inauguarated in 1935 is only about one-third completed as far as land acquisition is concerned. On the lands acquired, much has been done to improve hydrologic conditions and reduce erosion and excessive water runoff through improved management and protection of the area. Some 18,000 acres of forest plantations have practically eliminated erosion and reduced water runoff on old field lands wnich formerly contributed heavily to floodwaters and stream sediment. Forest fire protection has done much to build up hydrologic condition of the soil over the whole area.

The Secretary of Agriculture last spring transmitted to Congress a program for the national forests which contemplates a vastly stepped-up program in national forest management to meet increasing demands for all forest resources. Conspicious by its absence from this program was any mention of purchasing additional lands to complete the program on units with inadequate ownership, such as the Hoosier National Forest. There are undoubtedly other such national forest units where purchase of additional lands to consolidate ownership, form an economical management unit, and realize the full benefit of the program is necessary. I am informed that the Wayne National Forest in Ohio, and the Shawnee National Forest in Illinois are in a similar status.

I am not in favor of increasing Federal landownership as a principle, but I believe this case to be an exception where management of these lands in private ownership is not adequate to protect public interests in protection of watersheds and perpetuation of timber supply. I am informed that the annual appropriation to the Forest Service for land purchase in recent years has been about $100,000. Since 1957, the Wayne-Hoosier National Forest has been allotted a considerable proportion of this ($15,000 to $20,000 annually) which will purchase only from 1 to 2,000 acres annually. This is very slow progress on a worthwhile program.

In closing, I would like to urge your committee to consider the importance of this program to the overall water management program and to consider a sustained land purchase program adequate to the size of the task for national forest units such as the Hoosier National Forest and particularly for that forest. I believe my paper will provide adequate background on the Forest Service program there and would like it considered as a part of this presentation.

Respectfully yours,

THOMAS F. BARTON, *Professor of Geography.*

THE HOOSIER NATIONAL FOREST

(By Thomas Frank Barton, Indiana University)

INTRODUCTION

The largest publicly owned forest in our State is the Hoosier National Forest located in south central Indiana. This forest as of June 30, 1958, administered 120,821 acres while the 11 State-owned forests in southern Indiana administered 110,687 acres. Although the Hoosier National Forest is now 23 years old, little has been written about it. The writer has been able to locate only one small publication devoted solely to this project. This is "Quizzing the Ranger on the Hoosier National Forest," a Forest Service publication printed in Milwaukee, Wis., in 1957. Even though some were born and raised in the southern Indiana counties where it is located, few of the Indiana University students enrolled in geography 315 "Conservation of Natural Resources," during 1957–58, had ever heard of such a forest. This project potentially represents sustained forestry of about one-eighth of the commercial forest land in Indiana. Today it is one of the best, if not the best outdoor laboratory where woodlot owners can observe the practice of good forest methods. This paper is presented in part to assist the elementary, high school, and college teachers of Indiana who plan to offer a unit or lecture on the only national forest in Indiana.

HISTORICAL PERSPECTIVE

The Hoosier National Forest is one of six established on the Ohio River watershed (excluding the Tennessee) during the 1930's. The complete area of three of these six is on the Ohio River watershed, namely, the Hoosier National Forest in south central Indiana; the Wayne National Forest in southeastern Ohio; and the Allegheny National Forest in northwestern Pennsylvania. Of the remaining three, namely the eastern purchasing unit of the Shawnee National Forest[1] in southern Illinois; the northern part of the Cumberland National Forest in central Kentucky, and part of the Monongahela National Forest in eastern West Virginia, parts of these are found in the Ohio River watershed.

On February 6, 1935, the general assembly of the State of Indiana made it possible to create the Hoosier National Forest by approving an act to empower the Federal Government to buy land in the State for national forest purposes.[2]

EXACT LOCATION AND SIZE

This forest is not a continuous area but one divided into two parts (fig. 1). The larger unit extends north from the Ohio River in Perry County through Crawford, Dubois, Orange, Lawrence, and Martin Counties to the Greene County line. The area's maximum length is 69 miles, and its maximum width 26 miles near its center. Because of its serpentine boundaries, however, there are places where the unit is only 6 miles wide. This portion of the forest contains 534,558 acres.

The smaller unit is located primarily southeast of Bloomington and northeast of Bedford. This section contains 187,902 acres and is located primarily in western Monroe and southern Brown Counties; it also occupies small parts of northwestern Jackson and northeastern Lawrence Counties. This area has a more rectangular pattern with a length and width of 21 miles.

Combined, these units contain a gross area of 722,460 acres, or approximately 1,129 square miles. The Government does not plan to buy all the land within these boundaries. They are drawn for administrative purposes such as fire control. The latest estimate of acquirable land for this forest was made several years ago, and at that time it was suggested that approximately 490,000 acres could be ultimately purchased. Of the other 232,460 acres, most will be privately owned farmland interspersed within the forested region. This farmland will continue to occupy the larger and more level valley bottoms which are now being damaged by the deposition of debris from the adjacent steep and badly eroded valley slopes. Cultivation can also continue on the larger and more level interfluves[3] now being damaged by gullies originating on the sides of the valleys and working back onto the interfluves destroying the more level land. The owners of good farmland in the valley bottoms and on the interfluves will benefit by having soil erosion halted by reforestation on the valley slopes. National forestry policy is never to take good farmland out of cultivation that can be economically administered. The aim of the Hoosier National Forest is to acquire the land not suited for agriculture, reforest where necessary and manage such lands for timber production and for watershed protection. The slopes are so long and so numerous in this area that about two-thirds of the land needs to be in forests in order to protect the one-third which may be formed. Because of erosion and cropping much of this comparatively level and gently rolling land is low in fertility. This can be restored. The first step in such a program is to reduce as quickly as possible by reforestation, the erosion on the slopes.

RELATIVE LOCATION

It is necessary to understand the relative location of this national forest before one can evaluate the need for its development. Five phases of relative location will be briefly characterized, namely, 1, topography; 2, climate; 3, soil; 4, original and present forest land; and 5, type of farming.

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[1] Thomas Frank Barton. "Reforestation in Southern Illinois: The Shawnee National Forest Purchase Units," Transactions of the Illinois State Academy of Science, vol. 30, 1938, pp. 201–205.

[2] U.S. Forest Service, "Quizzing the Ranger on the Hoosier National Forest," Milwaukee, Wis., 1957, p. 3.

[3] An interfluve is the more level upland area between the valley slopes of two adjacent valleys.

Topography.—Nearly all of this forest is in the hilly unglaciated section of the State (a small amount of the forest land in Brown County was glaciated.) Although the project is located in parts of three physiographic regions, the Crawford Upland, the Norman Upland, and the Mitchell Plain, most of it is on the Crawford Upland. This upland contains the largest area of rugged irregular, and angular topography with maximum local relief of any region in the State.[4] Comparatively broad, flat-bottomed valleys are found adjacent to narrow interfluves and narrow ridge-like interfluves between narrow valleys. Professor Bushnell, an authority on the soils of Indiana, characterizes the landform area occupied by the Hoosier National Forest as "highly dissected tablelands with long narrow stream valleys, ranging up to 400 feet deep." [5]

Climate.—From a climatic standpoint the habitat for forest growth in southern Indiana is superior to that in the northern parts of Minnesota, Wisconsin, and Michigan where so much reforestation has taken place during this 20th century. All of the area in the Hoosier National Forest has an average annual rainfall of over 42 inches, and in the southern part adjacent to the Ohio River it receives between 44 and 48 inches. In parts of northern Minnesota the annual rainfall is about half the amount received in Perry County. The greater amount of precipitation contributes to more rapid annual tree growth.

Moreover, the growing season is much longer in the Hoosier National Forest than in the northern parts of Minnesota, Wisconsin, and Michigan. The southern part of Indiana's national forest has 180 to 190 days frost-free growing season, whereas in the northern part of the Upper Great Lakes States the length of the frost-free season drops in some places to below 120 days.

Other climatic factors might be cited such as the greater amount of sunlight in southern Indiana compared with that in the Great Lakes region.

There is less weather damage to forests here than in nearly all the other parts of the United States.[6] In spite of Indiana's superior habitat, reforestation is better developed in the Upper Great Lakes region than in our own because we have failed to take advantage of a superior habitat for the production of commercial forests. Indiana lags in the administration and application of forest technology.

Soil.—Since most of this forest is in the unglaciated section of Indiana, originally the valley slopes and interfluves had residual soils which, primarily, weathered from the underlying sandstones and shales. The weathering had gone on for millions of years before the pioneers appeared on the scene. During this time leaching helped retard the development of good soils. Unfortunately the heavy rains and the long period of time when the ground is not frozen, two important factors that aid tree growth, also contribute to rapid leaching. Consequently when the white man arrived, the soils now in the Hoosier National Forest were highly leached. When first cultivated, the virgin soils produced good yields, but they were soon carelessly damaged or destroyed through cropping and erosion.

The best soils have always been in the large valleys. Found here are three types of young transported soils; namely, alluvium, colluvium, and lacustrine. The lacustrine soils were deposited in glacial lakes occupying the ice-dammed valleys during the glacial period.

Man's occupance of the land brought severe soil erosion which in many places washed away residual soils and left the subsoil or barren rock exposed. Professor Bushnell rates the soils now included in this national forest as 85 percent susceptible to severe or very severe sheet and gully erosion.[7] The best land in the valley bottoms have not escaped soil erosion damage. Some of this land has been buried under several feet of debris eroded from the adjacent slopes and interfluves. Controlling soil erosion in this area is made difficult because the subsoil on the sloping land is only slowly permeable. But even where it is not badly eroded on the gentler slopes and interfluves, the stony loams are low in fertility.

Forest land.—Pioneers found the area now in the Hoosier National Forest covered with a broad-leaf deciduous forest of hardwoods such as the beech, oak, and hickory. Man occupied most of this land in the early settlement of the

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[4] C. A. Malott, "Physiography of Indiana," Handbook of Indiana Geology, the Department of Conservation. separate of publication 21, pt. II, pp. 98–102.

[5] T. M. Bushnell, "The Story of Indiana Soils," Agricultural Experiment Station, Purdue University, Lafayette, Ind., special circular (June 1944), p. 29.

[6] "Timber Resources for America's Future." Forest Resource Report No. 14, Forest Service, U.S. Department of Agriculture, Washington, D.C., 1958, pp. 215–216.

[7] Bushnell, op. cit., p. 37.

State. During this early period lumbering supplemented income made from cultivation. But the soil was never as deep and as rich as that in central Indiana. Soon virgin forests and virgin soil disappeared. After a few decades of cultivation, most of the land was left unplowed and permitted to revert to tree growth. A higher percent of the land would be in forests today had not three enemies hampered nature's replanting. These enemies are fire, grazing, and reclearing. Any number of times, just as nature restored a forest growth, someone would reclear the land, turn it into a woodland pasture, or a fire would sweep over it.

In 1935 when officers of the division of forestry, Indiana Department of Conservation, and representatives of the U.S. Forest Service drew the boundaries of the Hoosier National Forest, they found most of the land in forest, without having had any of the modern forestry practices applied to it.

In 1950, the Central States Forest Experiment Station surveyed the commercial forest land in Indiana. This survey was necessary because the U.S. census data on woodland are not too reliable and because exact and detailed information was needed to plan efficiently the use of commercial forest land in the Hoosier National Forest and Indiana. The results of this survey were published in a bulletin entitled "Indiana's Forest Resources and Industries." They confirmed the opinion held by many people; an opinion gained from the study of maps and field reconnaissance. This opinion or general belief was that the forested lands of the State were concentrated in southern Indiana and that here the concentration is chiefly on the Crawford and Norman Uplands (fig. 2).[8]

In 1950, nine counties, Brown, Crawford, Dubois, Jackson, Lawrence, Martin, Monroe, Orange, and Perry contained only 11 percent of the land in Indiana, but had 25 percent of the State's commercial forests.

Table 1 shows forest data for the nine counties in which the Hoosier National Forest is located.

TABLE 1.—*Total land and forest area of 9 counties, 1950* [1]

County	Land area (acres)		Percent
	Total	Forest	
Brown	207,000	150,000	72
Crawford	200,000	103,000	52
Dubois	277,000	86,000	31
Jackson	333,000	121,000	36
Lawrence	294,000	127,000	43
Martin	221,000	126,000	57
Monroe	264,000	132,000	50
Orange	259,000	124,000	48
Perry	246,000	162,000	66

[1] Ibid., p. 36.

Type of farming.—The Hoosier National Forest is located in the "south central general farming" [9] region of Indiana. It is characterized as an area of small farms, of abandoned cropland, of low subsistence from farming and as an area with the largest proportion of self-sufficing farms. Professor Bushnell recommended that the portion of this agricultural region now in the national forest should have "practically no corn" in its crop rotation and that only about 15 percent of the area should be cultivated.[10]

Summary.—After considering these five phases of relative location, it becomes obvious that the Hoosier National Forest is in a physical habitat conducive to the rapid growth of trees but poor for cultivation, except on limited areas of valley bottoms and ridge tops. The need to establish a forest under public management was apparent to those who observed that for decades good forestry practices were not and had not been followed. Moreover, there was enough forest land concentrated in a compact area to permit economical ad-

[8] O. Keith Hutchison, "Indiana's Forest Resources and Industries," Central States Forest Experiment Station, Forest Resource Report No. 10. U.S. Department of Agriculture. U.S. Government Printing Office, Washington, D.C., 1956.

[9] Lynn Robertson, J. W. Hicks, and E. C. Young, "Types of Farming in Indiana," Agricultural Experiment Station, Purdue University, Lafayette, Ind., station Bulletin 628 (December 1955), p. 24.

[10] Bushnell, op. cit., pp. 39 and 40.

ministration. Although there are over 4 million acres of commercial forest land in Indiana, about 3 million of these are so dispersed in small holdings that they should be managed as woodlots and not as public forests.

MULTIPLE PURPOSE FOREST

The Hoosier National Forest is designed and administered as a multiple-purpose forest. Its two primary objectives are: (1) to raise lumber and forest products, and (2) to improve conditions on the watersheds and to prevent erosion and excessive waterflow. Two commendable processes take place as slopes are reforested and protected from fire and grazing. These are the tree roots, not only anchor the soil, but carry fertility from deep in the earth and deposits it on top of the ground in leaves. The forest duff in turn protects the soil from erosion and holds the water. Consequently, reforestation provides watershed protection. The forest cover provides a habitat for the restoration of wildlife. And properly managed, the forest offers recreation opportunities. However, we should never lose site of the two paramount objectives for establishing the forest; namely, to grow lumber and forest products and to improve watershed conditions. If a conflict in forest use should develop, these paramount objectives should have priority.

PROGRESS

Land purchased: The first year (1935) that the forest was established, approximately 35,000 acres were optioned and approved for purchase. Had purchases continued at the same yearly rate, today the land planned for the forest would be owned and growing trees under proper supervision. Unfortunately, in January 1936, the National Forest Reservation Commission which must approve all national forestland purchases, suspended land acquisition in all units having less than 20 percent Government ownership. This ruling applied to the Hoosier National Forest units. Purchasing of land started again in 1939, but in these pre-Second World War years appropriations for land purchase by Congress were limited. In the Hoosier units, acquisition of land was restricted to certain areas adjacent to Government land. During this period an additional 35,000 to 40,000 acres were acquired.[11] Land acquisition was suspended during World War II.

"By 1952, the total land purchased and approved for purchase was about 109,000 acres." [12]

Since 1952 Congress has made only token appropriations for land acquisition for national forest land. None was available to the Hoosier National Forest until 1957. In 1958 this forest was authorized to take options on tracts of land adjacent to presently owned Government tracts.

As of June 30, 1958, the Hoosier National Forest ownership by counties is shown in table 2.[13]

TABLE 2.—*Hoosier National Forest ownership by counties*

County:	*Acres*	County—Continued	*Acres*
Brown	13,166	Monroe	15,267
Crawford	7,883	Orange	12,378
Dubois	0	Perry	40,524
Jackson	15,253		
Lawrence	8,521	Total	117,118
Martin	4,126		

Unless the rate of land acquisition can be speeded up, it will take nearly a century to obtain the land, and the opportunity for one stand of mature tree growth and harvest will be lost for much of the forest. Perhaps the two biggest bottlenecks in the development of this forest are sufficient funds and the lack of public support within our State. Apparently most people do not oppose the development of this forest, they are simply unaware of its existence and consequently uninformed about its need and potentialities.

Purchase of lands by the U.S. Forest Service is made on the open market. Lands suitable for national forest use are purchased as owners are willing to

[11] Personal letter from Howard C. Cook, forest supervisor, Wayne-Hoosier National Forest (Feb. 28, 1958).

[12] Ibid.

[13] Ibid. In addition, there are 3,703 acres in Martin County originally purchased as a land use project by the Resettlement Administration which is administered by the national forest.

sell and as funds are available. No lands are condemned or owners forced to sell.

Improvement of forest stands: As soon as land is acquired, timber stand improvements start. First the forest is adequately protected from fire. All fires cannot be eliminated, but the number, size, and damage from fires can be controlled. Second, forests are not grazed. When some areas are protected from fire and grazing, nature replants the area. Natural reseeding saves time and money.

Some areas are so devoid of suitable seed trees that planting is necessary. The first of these were made in 1936 covering 837 acres. During the year July 1, 1956, to June 30, 1957, 1,450 acres were planted. Between July 1957 and June 1958, plantings were made on 792 acres. As of June 30, 1958, the total amount of land successfully planted in trees is 17,726 acres. Some of these seedlings have reached a size where commercial thinning is possible.

To improve timber stands, selective cuttings are made. Over 1 million board feet were harvested in 1956 and 1.53 million in 1957–58.

Timber management of Tell City district: Completed surveys and a timber management plan for the Tell City district contain valuable data about three important forestry items namely: (1) The present timber stand; (2) expected growth in the next 10 years; and (3) the need for restocking. The study revealed that about 34,600 acres of the 69,750 owned by the national forest here contain sufficient timber ready for harvesting to make commercial cutting feasible. A 10-year program of cutting is in operation. Working progressively over the area three types of trees will be cut, namely: (1) mature trees; (2) deformed trees, and (3) poor growing stock which contain merchantable material. The removal of these trees will not only provide lumber and wood products, but it will also release water, soil, and sunshine for the growth of the more desirable and younger trees. Thus the ones that are left can make more rapid growth. This cutting has the dual purpose of harvest and timber stand improvement. After the harvest, cull or unmerchantable trees are cut or deadened.

Private employment: The trees are harvested by commercial timber sale. All timber is sold in the standing tree. Private sawmill owners and loggers fell the trees and remove the forest products under conditions set up in a sale agreement. Those to be removed are marked by the Government.

Public support: The Federal Government returns 25 percent of all forest receipts to the counties in which the national forest is located. The Indiana State forests give 15 percent of the net return from the sale of standing trees 14 inches and over in diameter to the counties. These moneys are paid in lieu of taxes.

Restoration of wildlife: "It is the policy of the Forest Service to consider the requirements for forest game habitat in all land-management activities and to permit public hunting on national forest lands under State game laws."[34] The Hoosier National Forest provides some of the most extensive public hunting areas in the State.

If birds and animals have water, food, and shelter, and if breeding stock is present, the birds and animals can restock the land. The growth of trees undamaged by fire and grazing provides the shelter. The State Conservation Department of Indiana and the Forest Service through cooperation agreements are providing water and food patches. The State conservation department receives funds from the administration of the national Pitman-Robertson Act. In 1957, part of this fund was used in Indiana to make the following wildlife improvements on national forest land: (1) construction of 42 game watering ponds; (2) maintenance of 10 game watering ponds previously constructed; (3) preparation of 22 acres of game food through clearing, plowing, and seeding; and (4) improved and maintained 315 acres of game food patches previously established.

Recreation: These forests offer many recreational opportunities. People drive through the forests and enjoy the scenery. Some can fish and hunt. For picnics the German ridge area and the Pioneer Mother's Memorial Forest near Paoli are popular. The German Ridge Area, near Tell City, Ind., includes a 3-acre lake with facilities for picnicking, swimming, and fishing. This area is administered cooperatively with the Cannelton Junior Chamber of Commerce. There is a small fee for the facilities. At the Pioneer Mother's Memorial Forest a small picnic area is maintained.

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[34] Progress Report (mimeographed), 1956–57 of the Wayne-Hoosier National Forest by Forest Service, Department of Agriculture, p. 6.

SUMMARY

About 490,000 acres of commercial forest lands suitable for the Hoosier National Forest are enclosed in its boundaries, but only 117,118 acres have been purchased during the past 23 years. Should we have as our goal during the next quarter of a century the purchase of 350,000 acres needed to administer the forest in the most efficient manner? Shouldn't we be able to complete its establishment in 50 years? If so, we have only 27 years left and about three-fourths of our purchasing job to complete. Even if the 490,000 acres of potential forest land were purchased and administered under proper forestry practices, a huge reforestation problem would remain. In Indiana about 3 million acres of commercial forest land are in farm woodlots and other small ownerships and poorly managed. The key to the solutions of our forestry problems is the proper management of these small forest holdings. When completed the Hoosier National Forest will be a solution to the proper use of about one-eighth of our State commercial forest lands.

Senator HART. I am advised that the State of Wisconsin would prefer to delay for a while, and I wonder if Robert Kellum of the Indiana Flood Control and Water Resources Commission is with us and would make his statement.

STATEMENT OF ROBERT W. KELLUM, REPRESENTING THE INDIANA FLOOD CONTROL AND WATER RESOURCES COMMISSION

Mr. KELLUM. Senator Kerr and Senator Hart. I represent the Indiana Flood Control and Water Resources Commission, as secretary of that commission. It is made up of 20 members of the residents of Indiana and there are 5 of those members ex officio representing the conservation department, the highway department, the health department, public service commission and the head of the engineering school at Purdue University.

It is headed by the owner of the Indianapolis Motor Speedway who has been the chairman since the founding of it May 1945.

I would like to point out, if it is convenient with the Senators, and not going into great detail about the data regarding Indiana. The committee has received the reports by mail and additional copies are here. If it is all right with the Senators I would like to get into what we regard as the committee's recommendations and suggestions to receive comments regarding what to do in regard to some of the mechanics of Government related to the handling of these water projects, if this is agreeable with the Senators.

The CHAIRMAN. Glad to have it.

Mr. KELLUM. We felt in working with this water resources that by and large the Federal agencies have done a tremendous job. I think that is important to put on the record. The Corps of Engineers, the Department of Interior, Reclamation and——

The CHAIRMAN. Agriculture.

Mr. KELLUM. Agriculture—have done by and large a very tremendous job in the development of this vital resource, but it is certainly timely that the committee does get into the problem of handling it more effectively because of the increased need as pointed out.

The water demands in Indiana will more than double by 1980, and I think that is the general consensus across the country.

The CHAIRMAN. What is the present volume that you use?

Mr. KELLUM. Our volume is in the billions. We have, of course, in our supplies here, we have 36 public water supplies, 47 surface water, and I am not just positive about the actual requirements on that at the moment, Senator. It is very substantial. It is in the printed record, the booklet.

But by use of industry by 1980 it is going to be something like over 5 billions of gallons a day.

The whole point in our feeling is that there can be a more effective cooperation in regard to the uses of water in pollution control.

1. New approaches to waste treatment to provide better and more economical removal of impurities, physical, chemical, and biological, that are detrimental to water uses.

2. A clearinghouse for correlation of research projects is necessary to insure early utilization of developments that will include the total utilization and to forestall unnecessary duplication of effort.

3. Improved methods of measurement of ground water resources and rate of recharge under various conditions.

4. Interrelation of surface and underground supplies. In our recommendations we get into the problem of coordinations in Washington, and I would like to interject here a word about the Murray bill for natural resources council. It seems to us to have a great deal of merit and there is a possibility for working toward a better coordination of especially the water resources field and better coordination of the developments and the planning for all of the uses as pointed out by the other States here. We certainly join supporting those recommendations for the watershed and more unified planning for all uses, all sites in the basinwide approach.

In the recommendations from the State as to the coordination in Washington:

1. We suggest a coordinating commission with members from departments of Government involved in water resources work as well as regional members appointed by the President with consent of the Senate, that would perform a valuable service as a clearinghouse for all water projects to provide a more orderly scheduling of projects throughout the United States. This commission could be formed along lines proposed by the President's Water Resources Study Commission. It would submit annual reports and recommendations to the Congress for action on water resources projects, among its duties.

2. Indiana proposes that funds for water resources projects under construction be budgeted in separate legislation and be approved by the Congress and the President prior to the start of each fiscal year, and that this approval be mandatory by that date each year.

I would just like to comment here that our experience in projects with the Corps of Engineers has been difficult in some regards because of the fact that the corps is not able to determine what money it is going to get until of course Congress passes its budget. But in addition to that it has to wait 30 days of course while the budget department looks over the bill. So there is no fund available until late October in some cases for any work to be done. That is too late in the construction season so that you are actually losing at least a half year or more. You are not just losing a month to work the funds into the construction season. In projects of this kind certain work cannot be done during the winter season.

3. Indiana proposes that a bill for authorization of new water resources projects be mandatory each calendar year, as such authorization requests are prepared and cleared by the necessary units of Government.

We feel this is so important to the Nation that there should be some action every year, that an omnibus bill should not be held until enough projects are in a bill for action but that it should be, even though it might be whatever number would be ready for action in any one year, it still should be not held up and should be acted on.

4. Indiana proposes that the Congress enact legislation requiring that an authorization for any water resources project would be terminated 10 years from date of enactment of the authorization if no funds for preparing final designs and specifications had been provided for the project by the Congress in that period.

We feel that there are quite a number of projects over the country that are on the list as authorized that are very inactive and never will be built. It would be clarifying, we believe, to have such a requirement to keep the position of the Congress and its relationship with the administrative department in better order and I think it would be of service to the Congress, we feel because it would know more exactly what the administrative departments would have to do and would be all-around beneficial in progress of water resources.

5. Indiana proposes that the Congress seek means to make records of the Weather Bureau, the U.S. Geological Survey and the Department of Agriculture more quickly available to State agencies in water resources work.

We are concerned with the Weather Bureau. It could be broken down. We understand it is a matter of funds from the Congress for a faster and a broader weather report and weather forecast.

Now as to the State-Federal relationships—

1. Indiana supports strongly the efforts in the Congress to obtain legislation which will clarify and establish the rights of the States to paramount jurisdiction in water rights law.

We back up Mr. Adams, the attorney general of Michigan, on that certainly.

The legislation, H.R. 5555, of Congressman Rogers of Texas, seems to us to be very good.

2. Indiana has been active in support of compact agreements between the States on water resources problems. We have membership, of course, in the Great Lakes Commission.

I might point out, Senator, that I think it would be safe to say in Detroit the production of automobiles has quite a bit of linkage with parts production and steel production in Indiana, that there might not be as many automobiles made if it were not for the tremendous steel production in the Calumet-Lake Michigan area and in the large parts production area of the major companies throughout Indiana.

So we are concerned with the Great Lakes. I am one of the five members from Indiana of the Great Lakes Commission, and we think it is making quite a bit of progress in the field of interstate relations and research for the better give and take on these problems of pollution and the other points that have been brought out, and I think Mr. Frost gave that.

Of course, the Ohio Valley improvement sanitation compact we feel is one of the finest developments in the country. Indiana was one of the supporting States in the activation of that compact back at the close of the war with Hudson Berry and some of them. I think Mr. Cleary is here in the room.

We are strongly in support of course of this approach and we think that the Ohio Valley compact has been very worthwhile.

We suggest encouragement of this compact approach on water resources and a basinwide approach on water resources.

We urge that all regions of the United States receive equal consideration and congressional determinations of water resources schedule and financing.

We would in that connection like to point out that perhaps the eastern part of the country has been a little lax because of the so-called humid ample supply of rainfall. Indiana has about 40 inches of rainfall a year on the average, but it is very spotty. We do feel now the increased population makes it mandatory that the east be given more consideration in this water resources problem and that there is a need for closer work between the States and the Federal Government in this basinwide approach.

I think that summary is in the text of the report. It does not in great deail mention the very important recreational phases of water resources, and we have no intention of slighting them in any way, and they are of course extremely valuable and are becoming more so and also the importance that navigation is growing with of course Indiana being bordered by the big waters and many small streams in the interior, with Lake Michigan on the north and the Ohio River, which as I understand, it carries two and a half times freight traffic of the Panama Canal each year. It is a tremendously busy and important waterway and so navigation and recreation are extremely important, and I know the committee gives them full consideration.

In that connection, Mr. Chairman, Mr. Charles Beckert of the Indiana Department of Conservation is here in the room.

Would it be all right if he said something on the recreation side? Would that be appropriate?

Senator HART. Yes. We would be very glad to have him say a word.

Mr. KELLUM. Thank you very much.

Senator HART. Thank you very much.

May I invite the Congressman from Michigan's Seventh Congressional District, Jim O'Hara, to join us at the suggestion of the chairman, Senator Kerr?

STATEMENT OF CHARLES H. BECKERT, OF THE INDIANA DEPARTMENT OF CONSERVATION

Mr. BECKERT. Senator Kerr and Senator Hart.

In response to your request, Governor Handley submitted a statement a week or so ago expresing the views of Indiana in regard to the State's water problems and suggestions or recommendations for solving some of these problems in order that the States might have an ample water supply for the next 20 or 25 years.

This statement was reviewed by the several agencies in the State dealing in water problems, prior to its submission to your committee,

and I wish to say that the statement clearly expresses the views of the Indiana Department of Conservation. However, because of the necessity of making a report as brief as possible, as suggested by your committee, there were a few aspects of a water problem not mentioned in the statement in which the conservation department is specifically interested and as Mr. Kellum indicated those problems are one of recreation, fish and wildlife propagation, the soil and water conservation, reforestation program and the collection of basic water resources data, all of which are being undertaken and is the reponsibility of the State conservation department.

I need not discuss the statement of Governor Handley as that had been amply done by Mr. Kellum. I have a brief statement I wish to submit to supplement the Governor's statement.

Because of a press of time I will not go into any detail, but I do want to say that the department is very much interested in the recreational aspects of all water resources development and feel that this matter should be given more consideration in future projects.

With growing population and the shorter workweek that we are facing, recreation will become more and more important, and we feel that it should be given greater emphasis and greater consideration in all future projects. It should be evaluated and if possible to set up criteria for determining the actual benefits and those should be included as a part of the project.

The fish and wildlife propagation and the use of hunting and fishing also affords recreation to our public and this aspect should also be given further consideration in the future project.

Our division of fish and game has worked closely with the U.S. Fish and Wildlife Service in appraising the effect of water impoundments on fish and fish propagation. The relationship has been excellent and the department has received much valuable assistance from the U.S. Fish and Wildlife Service in this regard, but we feel this should be expanded in the future and that the wildlife and fishing aspects should be evaluated and given its proper place in the consideration of the development of future water resources projects.

Our division of fish and game is concerned with soil and water conservation, particularly those which will affect our forests and the reforestation of eroded land in Indiana. The division has worked closely with the U.S. Forest Service, and we not only have State forest land in Indiana but we also have Federal forest lands.

Again, greater consideration should be given to these aspects. We are very much in favor of the present small watershed program. There are some 22 projects I believe now on file for approval. This program is going to do a great deal in solving some of our smaller flood problems and to improve drainage conditions and even the possibility of supplying water for water supply.

And the department feels that this program should be continued and accelerated as much as funds will permit.

Lastly, I would like to say that the department is the last liaison agency in the collection of basic water resources data with the U.S. Geological Survey.

We feel that there is an urgent need to accelerate this program and to collect the basic data that will be needed in solving the many water

problems in the State and in the Nation and that additional funds should be provided for this needed data.

The same applies to the topographic mapping of the Nation. Indiana is fortunate in this respect because within the next 3 years we will have completed the mapping of the State, but we feel that this should be continued in all the States and that the United States should be covered with topographic maps in at least as little time as possible because these maps are vitally needed in the development of any future water resources projects.

That is all I have to say and I want to thank you for the opportunity to express these views.

The CHAIRMAN. Thank you for giving us the benefit of your views.

(The prepared statement submitted by Mr. Kellum for Governor Handley follows:)

STATE OF INDIANA,
OFFICE OF THE GOVERNOR,
Indianapolis, Ind., October 1, 1959.

Hon. ROBERT S. KERR,
Chairman, Senate Select Committee on National Water Resources, Senate Office Building, Washington, D.C.

DEAR SENATOR KERR: The State of Indiana made a comprehensive survey of water resources in 1956, with forecasts on requirements to 1975 tabulated. The work was similar in many respects to that now being done by the Senate select committee on a broader scope. Therefore, we are sending 20 copies each of the Indiana Water Resources Report and Technical Appendix, for consideration by your staff.

Recommendations are made that, in general, increases of 1 percent a year from 1975 should be made to project the figures in this report to 1980. An exception to this projected increase should be made for the Lake Michigan-Calumet area in Indiana, where the rate of increase in demands for water will be much larger, due to the prospects for a new harbor and extensive steel expansions.

Indiana is proud to be a part of this coordinated study by the Senate select committee. We hope that improvements in the entire water resources program of the United States will be attained.

Attached are replies to your suggested outline of statements. The copies of the Indiana Water Resources Report and Technical Appendix have been mailed under separate cover.

Most sincerely,

HAROLD W. HANDLEY,
Governor of Indiana.

STATEMENT OF HON. HAROLD W. HANDLEY, GOVERNOR OF INDIANA

GENERAL INTRODUCTION

Water resources form the base for creation of new wealth, production of foods and fibers, processing, manufacture and improvement of the domestic living standards in the United States.

Indiana, 39th in size among the 50 States, is among the first 8 both in annual value of farm production and in annual value added by manufacture. It is 10th in population.

The State's increases in these classifications in the two decades, 1960–80, are expected to exceed the national averages, due to central location. Its water requirements, therefore, are expected to exceed the national average.

The following statements are in reply to the Senate select committee's general outline of proposed procedures.

Development of technical background:

1. EXISTING SITUATION AND TRENDS IN INDIANA

(*a*) *Summary of water resources available*

Average annual runoff from rainfall is 220 million gallons per square mile in Indiana. Total State surface is 35,536 square miles. Runoff is larger in the southern half of the State than in the northern half.

Groundwater reserves are spotty, but substantial in many central and northern Indiana watersheds and less plentiful in the southern one-third of the State.

(b) Withdrawal and use of water

Public water supplies in Indiana number 365. Of these, 47 have surface water as the source of supply and 318 use ground water. Most of the larger cities now have turned to surface storage, stream or natural lake sources There are 420 municipalities served from the 365 supplies. Many industries depend on wells for their water.

(c) Fundamental problems

Lack of balance between supplies of and demands for water remains the big problem. Rainfall is irregular.

Periods of drought and of flood have been and are being charted as a guide for future work to assure ample supplies and to prevent flood damages.

The great need is for more development of multiple-purpose projects at all levels of government—local, state, and Federal. Indiana is moving to accomplishment of some major programs of this kind in cooperation with the Corps of Engineers and the Department of Agriculture, as authorized by the Congress. A better coordination should be attained.

Stream pollution has become one of the most important problems throughout the eastern part of the United States and Indiana is well advanced in handling this challenge. Changing population concentrations call for new approaches to prevent pollution dangers.

(d) Ground water problems

The need for expansion of the ground water inventory activities of the Geological Survey, U.S. Department of Interior, is recognized in Indiana as urgent. Reports by this unit have been outstanding, as have the reports by the surface water branch. But increased demands for water make it essential that much more information on available ground water supplies be obtained.

(e) Water use for pollution abatement

The design of sewage treatment plants is based on treatment necessary to maintain satisfactory conditions at critical flow of the stream which is used for dilution. However, in many instances during periods of low flow, and in particular in the upper reaches of a watershed and in heavily populated areas, insufficient water is available to maintain satisfactory conditions below sewage treatment plants and industrial outfalls even with the best of treatment in use today. For example, in the upper White River Basin of Indiana, which contains more than 20 percent of the State population, during periods of low water the flow in the White River is utilized six to seven times in a 70-mile stretch. The requirement for dilution water builds up from the upstream reaches, where 5 million gallons daily additional would be sufficient on down through Indianapolis where at times an estimated additional 200 million gallons daily would be required for a minimum dilution of plant effluents.

2. PROJECTIONS OF FUTURE DEMANDS FOR WATER AND WATER RELATED ACTIVITIES

The report of the Indiana Water Resources Study Committee for December 1956 and the technical appendix thereto were utilized to project Indiana water use in 1980. Detailed information by subbasins is available in these studies. In most instances, the projected use in 1980 is obtained by multiplying the increase from 1954 to 1975 by 1.24 and adding this figure to the water use in 1954. In the Lake Michigan area the population and water use estimates were increased in consideration of port and industrial developments.

(a) Population forecast

The Indiana population in 1980 is expected to be about 6 million. The estimated population for 1980 was obtained by a combination of the population estimates from the 1956 water study report and population studies made in 1958 which indicated that Indiana's population was increasing at a rate of 72,000 per year. However, in the Lake Michigan-Calumet region of Indiana an entirely new city of 100,000 population within 15 years is predicted, in addition to other growth.

(b) Municipal water use

Projection for municipal water use by 1980 in Indiana indicates an average daily pumpage of 710 million gallons daily and a usage on an average day of a maximum month of 848 million gallons daily.

(c) Rural use of water

Water use in rural areas is divided into two parts:

(1) The use exclusive of irrigation water for 1980 indicates an average daily use of approximately 199 million gallons daily and a usage on an average day of a maximum month of 277 million gallons daily. This includes rural nonfarm and suburban use, rural farm and livestock uses.

(2) Irrigation use is difficult to project. However, if the increase was to continue at the same rate that it increased from 1950–54, use by 1980 could be as much as 3,920 million gallons daily during the peak irrigation season. It should be noted that other uses will also be at a maximum during this period.

(d) Water needs of industries

The estimated water use by industry by 1980 is 5,125 million gallons daily. This includes an estimate that industry's water usage in the Lake Michigan area would be three times the 1954 usage plus twice the 1954 usage in other basins.

(e) Electric energy

The principal use of water in Indiana for electric energy is for cooling requirements of steam plants. The projected use indicates that at least 13,000 million gallons daiiy of water will be required for this purpose in 1980. The majority of this use will be supplied from Lake Michigan and the Ohio River. Inasmuch as 1 percent or less of this water is consumed, water available for this purpose would be utilized for other beneficial uses.

3. MEANS OF MEETING FUTURE DEMANDS (NEW TECHNIQUES)

(a) Conventional methods of adding new supplies and costs thereof

Water, sewage, and industrial waste treatment systems and facilities must be continually expanded and improved to keep pace with population and industrial growth. It is estimated that Indiana municipalities and industries must spend at least $60 million per year, based on present day costs, on water utilities, sewers and waste treatment facilties to correct deficiencies and to provide for future needs. In critical water areas even these expenditures may not be adequate to maintain water quality suitable for beneficial uses without expensive pretreatment.

(b) Vegetational management (reduction of evapo-transpiration)

New forage crops are being used to benefit of landowners in many parts of southern Indiana, where clay soils prevail. The Southern Indiana Experimental Forage Farm, purchased by donations and situated northeast of Jasper, Ind., in Dubois County, is managed by Purdue University and has outstanding research results in reclaiming marginal lands. A pilot watershed in western Indiana is being planned to be the site for comprehensive studies on all phases of soil-water management.

(c) Weather modification

Little anticipated benefit from this source can be expected in Indiana due to the close proximity of varied interests in crop production and the lack of ability of weather (or rain) makers to hit target in small plots.

(d) Evaporation reduction and seepage control

No detailed work on this has been done in Indiana, but it would provide beneficial data if undertaken on a joint State-Federal basis. Efforts aimed to that goal are being started.

(e) Desalinization

Indiana, being inland, has no immediate contact with this research, but the Federal studies and tests of the various methods to reach practical desalinization are being watched with interest as holding promise for benefits to large regions near the coasts.

(f) New techniques in multiple-purpose river management

Indiana now is engaged in comprehensive development of the river basins in the State, in cooperation with the Corps of Engineers. It also is encouraging and assisting formation of conservancy districts in small watersheds for advancement of well-rounded water-soil projects, as planned by the Soil Conservation Service, U.S. Department of Agriculture.

The major problem is in applying engineering and governmental knowledge already at hand to the accomplishment of coordinated works, rather than in use of any new techniques, as such.

Perhaps one method which may be regarded as new for the purposes of this committee is flood plain zoning. Designations of these areas should be well defined, under local, State and, perhaps in some cases, Federal legislation. Indiana has begun work in this phase of flood control.

(g) Effects of nuclear energy

Development of nuclear energy for production of electricity will bring a demand for water on an ever-widening scope and in locations where, heretofore, water has not been available in sufficient quantities to justify the planning of a generating plant. This will call for increased surface water storage in all feasible locations within the watersheds of Indiana.

(h) New technical methods of improving water supply

Increased demands for water make it imperative that research be undertaken toward improved methods of water supply and waste water treatment. The following should be considered first for research:

1. New approaches to waste treatment to provide better and more economical removal of impurities, physical, chemical, and biological, that are detrimental to water uses.

2. A clearinghouse for correlation of research projects is necessary to insure early utilization of developments that will improve the total utilization and to forestall unnecessary duplication of efforts.

3. Improved methods of measurement of ground water resources and rate of recharge under various conditions.

4. Interrelation of surface and ground water supplies.

SUMMARY AND RECOMMENDATIONS

These points, in summary and recommendations, are represented by Indiana:

Summary

The need for water will more than double in Indiana by 1980, from this date (1959). This is an example of the trend nationally.

On an annual basis, volumes are available to meet these demands—and beyond—but much greater coordination in providing them, as to time and place, is imperative.

This calls for improved, and especially faster, methods for accomplishing projects for basinwide management of water resources in the public interest—including reservoirs for all possible benefits, flood control works, low flow regulation, soil-forest improvements in relationship to water runoff or retention, channel clearance, supplies, and especially pollution control.

Techniques at hand are the result of vast improvements, both in engineering and in equiptment, during the last 30 years. They are sufficient to accomplish large scale projects that would meet the water needs of all regions of the United States in the next half century. Research should not be cut back. Rather, it should be continued aggressively on all fronts.

The most urgent requirement is for improved governmental management at all levels—local, State, and Federal—with each of these recognized as having responsibilities in this field due to complexity of the water resources pattern.

Indiana supports the work of the Corps of Engineers, U.S. Army, in water resources projects. We believe that nowhere else in the world is there an agency of such caliber as the Corps of Engineers which works, under congressional direction, to accomplish projects for the upbuilding of the Nation in peacetime and which is ready, at immediate call, to convert to fighting form in case of any emergency which might threaten the safety of the United States. We believe this to be a truly outstanding exemplification of the American system of government.

Indiana supports the programs of the Department of Interior, in its scope of operations for improvement of resources management and in natural resources record keeping. Indiana supports the Department of Agriculture, especially in the Hope-Aiken small watershed projects which are aimed primarily at benefits to landowners within the specified smaller, upvalley areas. Indiana now has 30 applications on file for these small watershed programs which are planned and advanced by the USDA Soil Conservation Service.

Indiana supports the activities and objectives of the Federal Department of Health, Education, and Welfare in water sanitation advancements.

Indiana views the minute-by-minute services of the Federal Weather Bureau as absolutely essential to water resources programs.

Recommendations

Coordination in Washington.—1. A coordinating commission, with members from departments of Government involved in water resources work as well as regional members appointed by the President with consent of the Senate, would perform a valuable service as a clearinghouse for all water projects to provide a more orderly scheduling of projects throughout the United States. This commission could be formed along lines proposed by the President's Water Resources Study Commission. It would submit annual reports and recommendations to the Congress for action on water resources projects, among its duties.

2. Indiana proposes that funds for water resources projects under construction be budgeted in separate legislation and be approved by the Congress and the President prior to the start of each fiscal year—and that this approval be mandatory by that date each year.

3. Indiana proposes that a bill for authorization of new water resources projects be mandatory each calendar year, as such authorization requests are prepared and cleared by the necessary units of government.

4. Indiana proposes that the Congress enact legislation requiring that an authorization for any water resources project would be terminated 10 years from date of enactment of the authorization if no funds for preparing final designs and specifications had been provided for the project by the Congress in that period.

5. Indiana proposes that the Congress seek means to make records of the Weather Bureau, the U.S. Geological Survey, and the Department of Agriculture more quickly available to State agencies in water resources work.

State-Federal relationships.—1. Indiana supports strongly the efforts in the Congress to obtain legislation which will clarify and establish the rights of the States to paramount jurisdiction in water rights law. The legislation, H.R. 5555 (Rogers of Texas), is an example of the type which would be desirable in this regard.

2. Indiana has been active in support of compact agreements between the States on water resources problems. It was one of the first States to support the Ohio River Valley water sanitation compact, which has made exceptional progress in pollution control throughout the Ohio River Basin. Indiana, also, is active in support of the Great Lakes Commission as a means of contact between the States for development studies and coordination of policies. More recently, the Congress has approved the Wabash River Valley compact between the States of Indiana and Illinois for developmental studies in that basin.

Therefore, Indiana suggests the possibility of the Congress encouraging basinwide compacts between the States, with Federal representation, for the full-scale development of water resources in the respective areas—but without interference to State governmental departments active in this field.

3. Indiana emphasizes that great progress has been made in water resources development throughout the United States in the last 30 years and wishes to point out that, from a peak view, the Congress and all Federal agencies in this work deserve commendations from the public for guidance of these projects which are, truly, an investment in the future of the United States. More efficient methods for local-State-Federal cooperation should be sought, due to the imperative need for action on water resources programs as population grows.

4. Indiana urges strongly that all regions of the United States receive equal consideration in congressional determinations of water resources schedules and financing, with attention to the increasing needs in the eastern part of the Nation being well defined.

5. These recommendations do not repeat several points directed to more technical phases that are included in the text of this report. Furthermore, it is

suggested that many technical problems, such as methods for determining cost-benefit ratios on water resources projects, should be referred by the Senate select committee to a special study group for a report back to the Senate select committee. This could be one task for a coordinating commission.

6. Principles, as defined by the Constitution of the United States, should be reviewed repeatedly as guides for keeping relationships between local, State, and Federal levels of government on balance in water resources activities that are basic to strength and growth of the Nation.

The CHAIRMAN. Mr. Ray G. Tulane, assistant attorney general of Wisconsin.

STATEMENT OF RAY G. TULANE, ASSISTANT ATTORNEY GENERAL, STATE OF WISCONSIN

Mr. TULANE. Mr. Chairman, may I say that I consider it a privilege to appear once more before the distinguished chairman of this committee and his colleagues. The chairman may remember that the last time I appeared before him he questioned me so vigorously that I thought I was back in the courtroom and I addressed him as Your Honor.

The CHAIRMAN. I thought you gave a mighty fine account of yourself that day, and I am sure you will today.

Mr. TULANE. My statement will be as brief as I can make it, Mr. Chairman. Our prepared statement is on file.

In connection with that statement, I would like to emphasize once more the proposition that we regard in Wisconsin as fundamental, and that is that in all of these problems there should be a reasonable balancing of powers between the State and the Federal Government. That is, in Wisconsin we are not adamant States-righters and we do not feel we should have control of the forces which may be affected with a national interest.

On the other hand, we do not feel that these problems can all be run from one headquarters on the banks of the Potomac, and we do feel that the approach that was taken by Congressman Bonner's committee in the boating bill which passed the last session of the Congress, and which now has been implemented by legislation in some 26 States, indicates an approach which might be appropriate and considered in development of all of our water resources.

In our prepared statement we cover four subjects. The first is the lakes and streams, the surface waters, and we have particular concern with the use of our Great Lakes.

The second is the use of underground waters. The third is the consideration of the problems involving diffused surface waters, and finally the problem of weather control.

It is particularly in regard to our lakes and streams that we feel that the powers must be balanced between the State and the Federal Government. I will not say much about the Great Lakes and the diversion controversy now because that is in litigation. But I will repeat the statement that our attorney general, John Reynolds, has made publicly and which he has stated to the Supreme Court of the United States—that is, that we do not share the belief of some States that we have a right to insist that waters cannot be taken out of the watershed in which they are found. It has been done too many times.

With our exploding population, and particularly here in the heartland of the United States, the Middle West, the needs of water for

domestic consumption and industry are such that we must adopt a rational and reasonable principle in the use of the waters.

On the other hand, we cannot consent to any type of policy or legislation or anything which will dissipate one of our great assets which we regard as one of our treasures, and that is, the Great Lakes.

The policy that General Reynolds has advocated is that waters may be taken outside of the watershed if after use they are returned. In that way we feel that the needs of an expanding population can be met and at the same time successive demands upon the waters within the watershed will not deplete it and injure the basic interests of the people in that area.

Similarly, in regard to control of our purely intrastate lakes and streams, we feel that the rights of the States should be respected. I am thinking particularly of cases where the Federal Power Commission has authorized the damming and use of streams contrary to State law. Now, when any State, such as Wisconsin or the State of Washington, charter a corporation and endow it with certain powers, you do not like to see that corporation go to some Federal agency and assert that it has more power than the State which created it. gave to it.

Similarly, we do not think it is fair when a State has created a municipality as a subordinate agency of the State for some Federal agency to tell that city that it can almost in effect thumb its nose at its creator and engage in activities which the State itself will not consent to. It is almost as though a stranger should come in and encourage children to be insubordinate to their parents.

In the field of such water control we do feel there should be cooperation and coordination between the State regulatory body and the Federal agencies which have an interest in regulating the use of the particular watershed.

We recognize that the waters do have an interstate aspect in many cases, particularly in regard to navigation and commerce, and we recognize the Federal interest in seeing to it that that interest is protected and maintained.

At the same time there are problems that are local and in the local problem we feel that the State should have something to say about the "scuttlebutt."

I do again recommend the Bonner bill on boating as one example of an approach which I think should be acceptable to all the agencies concerned.

In the matter of underground waters, that is primarily a local matter. We do appreciate the cooperation which we have received and are receiving in Wisconsin right now from the geological survey in the study of our underground water resources. We believe that is both a proper and appropriate activity for the Federal Government to engage in and it should be encouraged. At the same time the State is supporting that activity with its own funds and it is presently in active cooperation with the Federal agents. The problem of diffused waters is one which relates mostly to controlling and preventing runoff and that again is something which, in the end, will affect our interstate streams and can affect navigation on those streams. In this field we feel that both resource station and control of soil erosion are matters in which the Federal Government does

have an interest and in which appropriate activity can be engaged in by the Federal Government.

Coming to the subject of weather control, there is a matter which we feel is not only national in interest but may become international.

The clouds and the currents do not respect State boundaries, activities which may take place in one State can affect States two or three or four States away and farther, and can even affect the international boundary. In Wisconsin, we have at present only a law which requires reporting of any weather control activities which are attempted. That is for the purpose of gaining information so that if effective weather control ever becomes possible, we will have information on which to act.

At the same time we do feel that it is appropriate for the Federal Government to undertake studies in that field now so that when our scientists do develop something effective in the field we will be ready with plans and legislation.

If I could just return to the statement that I made at the beginning—if we approach the problem on the basis of establishing a reasonable balance of power between the Federal Government and the States, then I do believe that we will have effective legislation in this particular field.

The CHAIRMAN. Thank you, Mr. Tulane.

(The prepared statement referred to above follows:)

STATEMENT OF RAY G. TULANE, ASSISTANT ATTORNEY GENERAL, WISCONSIN

WISCONSIN'S WATER PROBLEMS—PRESENT AND ANTICIPATED UP TO 1980

A. Problems concerning lakes and streams:

1. Coordination and regulation of water use by different interests such as—

(*a*) Potable water supply for urban and rural use.

(*b*) Water supply for industrial processes and power.

(*c*) Pollution of lakes and streams by waste, sewage, and discharge of heated waters from riparian property, urban communities, industries, and water craft.

(*d*) Recreation involving bathing, boating, water skiing, aquatic plant control, hunting and fishing, shoreline improvements, and zoning of water uses.

(*e*) Fish and wildlife propagation.

(*f*) Consumptive use of water for irrigation and by industry.

(*g*) Variations of levels and flow due to changes in precipitation and control of impoundments.

(*h*) Adequate public access.

(*i*) Improvement of channels, ports, and harbors for commercial navigation and control of shoreline filling.

2. Definition of local, State, and Federal areas of responsibility.

3. Increased program of surveys and measurement of the resources and increased research concerning its use.

B. Problems concerning underground waters:

1. Preservation of adequate supply and coordination and regulation of water use by different interests such as—

(*a*) Potable water supply for urban and rural use.

(*b*) Water supply for industrial processes.

(*c*) Water supply for irrigation.

(*d*) Provisions for recharging aquifers.

(*e*) Prevention of contamination.

(*f*) Effect of withdrawal of ground water on natural springs and ponds.

2. Review and redefinition of individual, local government, and State government areas of control over the resources.

3. More adequate surveys of extent and characteristics of the resource and increased research concerning its use.

C. Problems concerning diffused surface waters:
1. Improved control of diffused surface water in order to—
(*a*) Limit the loss of agricultural land from erosion.
(*b*) Minimize the silting of lakes and streams.
(*c*) Avoid the creation of salt marshes or lands through retention of salt from highway ice control programs.
2. Coordination of State and Federal programs:
D. Problems concerning weather control.
1. Prevent erratic or poorly planned weather modifications by cloud seeding or other methods which may be proven effective.
2. Determination and definition of individual, State, and Federal areas of responsibility.

Views as to the Solution of Wisconsin's Water Problems

A. Problems concerning lakes and streams

The present Wisconsin law concerning waters in lakes and streams is essentially adequate and sound. These laws give primary recognition to the rights of riparian owners and allow reasonable use of the water by them and by the public generally. The administrative agencies of the State charged with administration of these laws are well acquainted with their responsibilities under those laws and are carrying out their programs in a satisfactory manner. The increased use of this resource calls for an accelerated program of research, surveys and measurements in order that administration may continue to be effective.

The increase in the use of water in lakes and streams, including the heavy increase of recreational uses with associated improvements such as sand blankets, dredging and filling, and the correspondingly increased program of administration by State agencies, will call for increased appropriations to carry out that program. Changes in emphasis in different parts of the program will, from time to time, call for changes and amendments in the administrative law and rules to cope with the changed situations. Examples of such changes are those brought about by increased use of water for spray irrigation (which require careful permit control and strict enforcement to protect the public interest) even though Wisconsin is considered to be a humid State, and the increased interest in and necessity for port improvement and development resulting, in part, from the completion of the St. Lawrence Seaway and the connecting channels projects.

Because of expanding demands for water from the Great Lakes, Federal policy should be developed to state specifically how, and under what circumstances, water for domestic and other uses may be diverted from this source into adjacent watersheds. Such policy should include a requirement for return of this water to the Great Lakes after treatment for a high degree of purification.

The increased interest in, and use of, waters in lakes and streams has apparently stimulated the interest of the Federal Government in geographical areas where heretofore it has exercised little initiative. When Federal agencies enter into fields of activity heretofore handled almost exclusively by State agencies it becomes advisable to define and to periodically redefine the areas of responsibility of the State, local, and Federal governments. Recent examples of increased Federal concern are Federal flood control projects on small streams, water pollution control on interstate streams and the requirement of a Federal Power Commission license for dams on very small streams, many of which dams were constructed when the land was being first occupied over a 100 years ago.

B. Problems concerning underground waters

Contrasted to the law of reasonable use, which prevails with respect to the lakes and streams of Wisconsin, until recently, the law of underground waters has been that the owner of the land had the right to unrestricted use of the underground waters. Within the last few years a law has been in force which protects the underground water supply used by a municipality from being interfered with by the development and operation of high-capacity wells owned by others. Presently, wells owned by persons or corporations other than municipalities have no protection from the effects of other wells owned by their neighbors, including municipalities. The Natural Resources Committee of State Agencies and the legislature have considered this problem over the past 8 years but, as

yet, no further legislation has been enacted. It is believed further legislation should be enacted and administrative processes set up to carry out the new laws.

The underground water problems are becoming more pronounced. While they are presently the greatest in certain urban and industrial areas, there is an increasing use of ground water for irrigation in rural areas which will require attention. Here again additional funds will be required to make more adequate surveys of the extent and characteristics of underground waters in order that reasonable use of the resource may be assured through regulation by appropriate laws and administrative rules.

As yet, except for cooperative investigation of the resource, the Federal Government has not interested itself greatly in the underground waters of Wisconsin. It appears that this is a subject of local and State interest rather than of national interest, at least in the State of Wisconsin.

C. PROBLEMS CONCERNING DIFFUSED SURFACE WATER

The problems in this field all lead to the advisability of retarding the runoff of rainfall and, to a lesser extent, melting snow from the land. Retarded runoff has the triple advantage of restoring the ground water levels, minimizing the loss of valuable topsoil through erosion, and reducing the siltation of lakes and streams. The most effective means of accomplishing these purposes is through following well-known erosion control practices. A closely related activity is that of forest restoration in areas well adapted to forest growth and where soil erosion and rapid runoff will otherwise take place.

Both State and Federal agencies are active in this field and continual coordination of their programs is a necessity. Reforestation and soil erosion control are both appropriate subjects of Federal interest because of the great number of years necessary to develop a stand of merchantable timber and because of the essentially irreplaceable characteristics of our topsoiil.

D. PROBLEMS CONCERNING WEATHER CONTROL

Privately sponsored corporations, as well as individuals, have been active in this field in other States with indeterminate results. It seems probable that progress will be made in weather control during the next few decades. Whenever weather control becomes feasible and appreciably effective, Federal regulation will become an absolute necessity. Weather control which may be good for one State may have an adverse effect on the neighboring States. Certainly the kind of weather that is good for one industry is likely to be bad for some other industry.

Wisconsin has a law requiring only the reporting of activities in this field. No other regulation has been undertaken. This regulation was intended primarily to obtain the facts which might become available from attempted weather control operations by cloud seeding. When, and if, weather control becomes effective, it must, in our opinion, be controlled by the Federal Government, if not, in fact, through international agreement. The clouds and wind currents are not respectors of State or national boundaries.

SUMMARY OF COMMENTS

To summarize our comments on Wisconsin's water problems, it is our opinion that most of these problems hinge on what is the reasonable use of the resource by the individual, or other private interest, which will not infringe on public rights or unduly interfere with the public interest. For the most part the solution of these problems can be handled on a State or local level under present or modified laws and administrative rules. The Federal Government need interest itself only when inaction by State or local governments will result in an irreparable loss to the public or unreasonable damage to the people of a neighboring State. As a general principle, projects which are of purely local or State interest should, in our opinion, be financed by the State and the locality. The Federal Government has no source of tax revenues other than those extracted from local taxpayers.

On such things as subsidies for land drainage, Federal agencies should be coordinated so they do not spend money on projects which oppose the programs of other Federal agencies. In the past there has been a lack of such coordination among Federal agencies. Also, the Federal Government should not engage in acts contrary to State policy. In fact, there should be no Federal moneys advanced to foster projects not authorized and approved by the State.

COMMENTS OF SUBJECTS IN OUTLINE OF PROPOSED PROCEDURES FOR THE STAFF WORK OF THE NATIONAL (WATER) RESOURCES COMMITTEE

Each of the subjects in the outline is of importance. However, we will comment briefly only on those subjects which seem to pose particularly important or new problems for investigation.

FIRST PHASE—DEVELOPMENT OF BACKGROUND

IA. Summary of water resources available

Our comment on this subject is related to item IIC of the second phase, namely ways in which Federal agencies and others can help in meeting water needs. It is probable that when the summary under first phase IA is prepared, the committee will conclude that a great deal more work must be done to complete anything like a comprehensive inventory of underground water resources available. It is also probable that you will find a dearth of inventory information on the flow in small surface streams in different areas. We have found in most cases the decision in a particular case of proposed water use depends on the water resources available at the immediate geographic locality of the proposed operation, whether the proposal be to use a small stream or underground water.

The U.S. Geological Survey, in cooperation with the different States, has obtained considerable information on streamflow, particularly on larger streams, but much less information on small streams and very much less on the available underground waters in particular localities. For example, the limitations on the use of underground water in any particular urban area must usually be determined in that particular area rather than from generalized knowledge of the character and general extent of the aquifer from which the underground water is to be drawn. The necessity of obtaining this type of information is not generally understood by the layman or by legislators, and promotional activities by the Federal Government in obtaining this sort of information through cooperative procedures is most important.

IIC. Agricultural use of water

During the last several years there has been considerable promotional work to encourage the humid States east of the Mississippi River to adopt some modified form of the western water law of prior appropriation in lieu of the present law based primarily on riparian ownership and public rights to the use of public waters. We are of the opinion that this sort of promotional work in the humid States by Federal agencies is inadvisable for the reason that the riparian type of law with suitable modifications for local application is better suited to the humid States than a law of prior appropriation. This is true because of the more extensive use of the streams in the Eastern States for recreation, fish and wildlife, navigation, and use by the public generally. The resort industry of Wisconsin, for example, depends largely on the use of lakes and streams untrammeled by prior appropriation restrictions. Likewise, the use of small streams for the watering of stock and other urban, industrial, and general agricultural uses by all of the people should not be limited by prior appropriation by a comparatively few agricultural developments.

IIG. Flood control

Many of the flood-control problems are created by the construction of buildings and other improvements in the natural flood plain of streams regularly subject to spring freshets. County and other local governments apparently are reluctant to adopt zoning ordinances which prohibit the construction of buildings in the natural flood plains of the different streams. Promotional work by the State and Federal Governments to encourage such zoning would not only limit the damage created by floods, but would reduce the tendency toward Federal expenditures for flood control necessitated by unwise industrial and urban developments within flood plains. Encouragement of the establishment of conservancy districts for recreational use zoning of flood plains should be increased.

IIIC. Weather modification (induced precipitation)

We are of the opinion that this is a field where work by Federal agencies would be particularly appropriate and helpful. The subject is one of national, if not of international, significance. No single State is in a position to determine the effectiveness of weather-control measures nor the results achieved or created by weather modification procedures. Neither is any State in a position

to regulate weather modification activities so as to insure beneficial results to the greatest economic benefit of the public without seriously and adversely affecting other large segments of that public. If effective weather-control techniques are developed and used, there appears to be an enormous field for public benefit, but also a likelihood of endless litigation between groups or segments of the population who are damaged by rainfall which is beneficial to other groups. Such litigation would, in all likelihood, arise between groups in different States, if not between different nations. The Federal Government should certainly take the lead in this field of research development and regulation.

SECOND PHASE—STAFF ANALYSIS

IIC. Ways in which the Federal agencies and others can help in meeting water needs

The Federal Government can be most helpful in pursuing the lines of research and factfinding followed by the Weather Bureau, U.S. Geological Survey, Soil Conservation Service, and perhaps a few other agencies insofar as they concern themselves in those necessary activities which would not likely be adequately pursued by all State and local governments. The results of such research and fact-finding activities should be made available to all interested persons through appropriate publications and promotional activities. Grants in aid from the Federal Government and subsidies to carry on those programs which the State and local government can well carry on themselves should be avoided wherever possible. Once a Federal appropriation has been made for such grants in aid every State must take advantage of those grants or it finds its citizens paying Federal taxes to support such activities without benefit. It should be borne in mind, in all activities, that the only source of funds is the individual taxpayer and that there is no source of Federal funds which does not have an impact on that taxpayer's resources.

VIEWS ON MATTERS MENTIONED IN SENATE RESOLUTION NO. 48

Section 3 of this resolution outlines in general terms the tasks and duties of the committee. Subsection (*b*) of section 3 charges the committee with recommending the character of legislation to accomplish a number of things with respect to the water resources. Presumably it is inferred in this charge that the recommended legislation will indicate at what level of government the different promotional and development activities should take place, whether at Federal, State, or local governmental levels. It seems to us most important that the committee recommend for Federal legislation only those matters of true Federal or national concern and that it recommend for State consideration and possible legislation those matters which can be handled adequaltely by State and local governments. The State should have paramount control over the destiny of its purely intrastate lakes and streams to the end that State water policy cannot be upset by dam building permits granted by any Federal agency. Only in this manner can responsible State and local governmental responsibilities be maintained. The strength of our Nation lies in the strength of its State and local governments, in the will of its individual citizens and in the general guidance and coordination of the Federal Government.

The CHAIRMAN. Senator Hart, it is with the deepest regret that I must leave. I would like to make just a brief statement before I do.

I think it is apparent to every person in this room and will be to everyone fortunate enough and diligent enough to read this record, that, first, this is one of the best prepared and presented hearings that we have had; and second, the question before the committee is of such transcendent importance, not only to Michigan but to the other States of the Great Lakes area as well as the entire Nation, that diligent effort must be made by the committee to secure the most comprehensive information that it can.

Actually the committee is under a tight deadline. The resolution which created it provides for its termination by January 31, 1961. We face the necessity of the accumulation, coordination, and analysis

of information by the end of the first part of 1960 so that agreement can be reached as to the recommendations of the committee and the preparation of its report.

It seems to me, Senator Hart, that we would be doing the country, the States, and this committee a great service if we found a way of coming again to the Great Lakes area even while the Congress is in session, maybe in January. We already have scheduled hearings up through the 8th of December. It will be my hope, if local interest justifies it and local cooperation is available to implement it, that we can come again to one of the States in the Great Lakes area for even more than one day's hearings. I hope that the committee will see fit to make that opportunity available if there is response that would make it fruitful and productive.

I am very disappointed at not being able to hear some of the papers that I have noted are going to be given. I want to assure you that both the staff and I will read them as carefully as we are able to and with the greatest interest.

Senator HART. Mr. Chairman, thank you very much. I am delighted that you do sense in this morning's session sufficient awareness of our problem and you will indicate to the committee that perhaps we should return for another day or two of hearings in the Great Lakes Basin.

I am delighted that you have been with us thus far. I only regret that you will not have an opportunity to meet some very distinguished scholars in this field who are willing to share with us their findings as well as, you will be glad to know, the League of Women Voters.

The CHAIRMAN. They have been with us in every State and they made one of the most valued contributions that has been made to this series of hearings by any organization.

I think one of the most wholesome developments in this country is the attitude of the League of Women Voters. They have approached it effectively, studiously, and they have come up with a program of information to their members and others interested. They call it "Know Your River Basin" and I was especially interested in what witnesses have said here about the river basin approach. I think it is an absolute necessity and, of course, the knowledge of the resources of each individual river basin must be accumulated and understood in order either to comprehend this problem or hope to arrive at an appropriate and worthwhile solution.

I want to say, Senator, that my association with you has been very, very happy, and the growing interest you manifest in this work and this activity of this committee is of tremendous benefit to it. I know you are aware of the fact that you are one of the two men on this committee from east of the Mississippi River. Many wonder just why so much emphasis has been and is being given to the West. I believe a remark by one of the witnesses here this morning is quite enlightening in that field of information.

He said he believes the time has come when the Federal Government should take a more detailed view of the necessities of the area he referred to as the humid—what did he say?

Mr. SCHAD. Humid, that is right, plenty of water.

The CHAIRMAN. The areas which heretofore have been regarded by the people within them that they had plenty of water. I think as we look ahead in this country we are compelled to form the conclusion

that the areas which have most water have the greatest potentiality and the greatest resources and the greatest riches. But I think the passing of each decade will make it more and more clear that no area has too much water. The emphasis has been largely in the western and southwestern part of our country. They have been aware of the necessity if they are to have any part in the development of the great industrial economy of the Nation that they must conserve and make available for utilization their vast water resources.

You know there are 17 so-called reclamation States, that is, States in which the Bureau of Reclamation operates. I frankly think that the time is approaching when many more of the States will be within the area served by the Bureau of Reclamation. I think it is imminent when the entire area of the United States will be regarded as within the area available or eligible for the work and service of the Bureau of Reclamation. I think that the statements and papers presented here this morning support that view, and I think that the further we go and the more we learn about the accumulated mass of local problems and local needs, the better picture we are going to have of the national requirements. As I said to open this statement, I regard the sum total of the Nation's requirements as probably the greatest economic opportunity the Nation has, because we do have the water and we must develop a plan whereby it can be used and reused and reused to meet the growing expansion of this great Nation.

Senator HART. Senator Kerr, thank you very much.

The CHAIRMAN. Thank you.

Senator HART. Speaking for the Ohio Valley Sanitation Commission, Mr. Cleary. I know he was here.

Mr. Cleary, I may indicate, is on the interstate agency representing Illinois, Kentucky, Indiana, New York, Ohio, Pennsylvania, both the Virginias; and it has already been described as a most effective one.

STATEMENT OF EDWARD J. CLEARY, EXECUTIVE DIRECTOR AND CHIEF ENGINEER, OHIO RIVER VALLEY WATER SANITATION COMMISSION

Mr. CLEARY. Senator Hart and Congressman O'Hara, I have filed a statement with the committee and copies are available for the various members as well as for the staff.

The Ohio River Valley Water Sanitation Commission is an interstate compact agency created with the approval of the Congress of the United States.

In my remarks today I am going to summarize what is in this general statement that I have prepared for the committee. I should add that the commission is an instrumentality of the States of Indiana, Illinois, Ohio, Pennsylvania, New York, Virginia, West Virginia, and Kentucky. And each of these States is pledged by this compact to faithfully cooperate in the control of pollution of the waters of the Ohio Valley. The compact was signed in 1948 by the Governors of the eight States and there are three representatives on the commission representing the Federal interests, namely, the Corps of Engineers, the U.S. Public Health Service, and the U.S. Fish and Wildlife Service.

Our commissioners were motivated by a desire to share with your committee the experience of the eight States in this regional crusade

for clean streams. In particular, they wish to emphasize the fundamental role of pollution control in safeguarding water resources for present and future demands.

In many parts of the Ohio Valley, the problem of maintaining the quality of water resources overshadows problems related to quantity. This is not to suggest, however, that there is sufficient quantity of water in all places at all times. In the Wabash, the Scioto, and the Mahoning River Basins, to name a few, the availability of streamflow at certain times is somewhat less than might desired. Our commission has gone on record in support of multiple-purpose projects that would augment low streamflows.

But on the Ohio River, which is the focus of the commission's attention, the quality considerations take precedent over those relating to quantity. Consider, if you will, a typical situation such as that existing at Louisville, on the Ohio River. Every time you take a breath 3 million gallons of water passes by Louisville. In that same period of time for you to take a breath Louisville requires less than 3,000 gallons of water. Virtually all of this is returned to the river after passing through a sewage treatment plant.

In other words, the available quantity at Louisville is about 1,000 times greater than present requirements. So, with regard to water, the principal concern at Louisville as well as some other 115 municipalities and 81 industries that draw water from the Ohio, is not quantity. The problem is quality.

If quality is suitable for domestic and industrial uses, then it will be suitable for this important and growing use of recreation.

Prior to the establishment in 1948 of this Ohio River Valley Water Sanitation Commission, Louisville had reason to be greatly concerned about the quality of its water resource. This great interstate river, the Ohio, passing Louisville, carried with it the untreated sewage from millions of people and waste discharges from hundreds of industries. With virtually no one upstream providing any control of waste, it was no small wonder that Louisville felt no compulsion to purify its discharge. As a consequence the Ohio River was further degraded in quality.

Today, however, there is reason for the citizens of Louisville, and all of its Ohio River community and industrial neighbors upstream and downstream, to believe that progress is being made in safeguarding these water resources, and the reason stems from the knowledge that the eight States who pledged faithfully to cooperate in the control of pollution are redeeming that pledge in full measure.

To recite only one aspect of this accomplishment, the commission began its work in 1948, less than 1 percent of the 3,600,000 people who live along the banks of the Ohio River provided treatment for their sewage. Today, 95 percent of the pollution has a treatment plant operated or being readied for operation just as fast as the construction contractors can complete them.

In the meantime, so far as industrial wastes are concerned, three-quarters of the industries have installed control facilities. Not all of them are adequate to meet ultimate necessities for safeguarding water quality. But it can be said that a majority of industries have now done something to prevent degradation of river quality as contrasted with virtually nothing some years ago.

Substantial as this progress in pollution control may be, it is really only the beginning in development of a quality management program in the Ohio Valley to satisfy future water needs. There are certain aspects of the present program with which the commission can hardly concede satisfaction. For example, there has been little success yet in minimizing the discharge of acid water from active and abandoned coal mines in the upper Ohio and its tributaries. Oil pollution continues to be a major source of complaint. The commission also recognizes that much more needs to be done in curbing other discharges that contribute to the formation of tastes in water supplies. And with the more subtle physiological aspects of quality degradation, notably those related to potential toxicity hazards associated with certain wastes, the commission has long been concerned. In fact, as far back as 1950 the commission initiated studies on the toxicity evaluation at the Kettering Laboratory.

This in brief summarizes some of the activities and aspirations of the eight States in meeting the challenge of safeguarding water through pollution control.

The details are contained in the annual reports, two of which I have supplied to each member of the committee and form part of my statement.

Let me come to the matter of experiences and conclusions.

Experiences in the Ohio Valley reveal that there are vast opportunities for preservation of the quality of water through effective pollution-control practice. In order to realize these opportunities, however, the following conclusions would appear to have validity:

1. It is unrealistic to assume that the solution to pollution problems is simply a matter of devising legal prohibitions. Laws forbidding the pollution of waters have been on the statute books of our States for scores of years. But progress in securing clean streams has shown little relation to the number or stringency of legal measures designed for this purpose.

2. Neither is it realistic to believe that progress in expediting water-pollution control must be paced to research effort and the development of further technical knowledge. This does not deny that certain problems command all the research and scientific talent that can be made available that can be brought to bear on them.

The point I am making is this: Much pollution could be abated now simply through an aggressive application of what we already know. The lack of willingness rather than the lack of know-how is the obstacle to pollution control in many situations.

3. This is a third conclusion based on those two. If we do not lack for laws and technical knowledge, then what is the reason why advancement in pollution control has been so frustrating? The answer, in brief, might be this: to gain acceptance by municipalities and industries of the obligation to control their waste discharge and thus protect the welfare of downstream neighbors is an exercise in social reform. Social reforms are achieved by bringing about a change in public attitudes and values. It is my conclusion that where progress has been made in pollution control it has resulted in large measure by first inspiring and then bringing about public understanding and support.

In this connection we might think of the profound remark of Abraham Lincoln. Talking about the manner in which to achieve changes in a democracy, he said:

> Public sentiment is everything. With public sentiment nothing can fail; without it nothing can succeed.

This viewpoint, I know, is shared by your chairman, Senator Kerr, with regard to the work of this committee. He has stated, and I quote:

> It is my hope that we will be able to make such a dramatic presentation of what is needed to be done that it will lead appropriate authorities to make the necessary decisions.

I believe it is fair to conclude that the relation of pollution control to the preservation of water resources has not yet been adequately dramatized for the American public and their leaders in legislative halls.

It has been most encouraging that the League of Women Voters has made water resources one of their major study projects during the past 2 years and has so vigorously espoused this course and brought about public understanding and appreciation.

Now a fourth conclusion. Considering the fundamental importance of pollution control in obtaining maximum benefits from water resources, as well as the magnitude of the tasks associated with it, State legislatures might well inquire as to the adequacy of funds appropriated for this purpose. It has been traditionally maintained that pollution control is a State responsibility. But it is questionable if even the rudiments of this responsibility can be carried out in any State with a staff of only six people. Yet such actually is the case in one of our growing and rather heavily industrialized States. Other situations of similar disparity between personnel and workload would not be difficult to find.

And it might serve a useful purpose, Senator Hart, if this select committee could make an inquiry among the States and determine how much money and personnel is being devoted to the enforcement of water pollution control and the nature of the program being undertaken. I believe such an evaluation would be unique and could provide the basis for recommendations in expediting progress in this fundamental job of safeguarding water resources.

My final conclusion is this: That because of the lack of funds, the personnel, there has been a great efficiency in the conduct of effective pollution control in two respects. Since the States are pitifully understaffed and have had to neglect certain things, the two essential elements of water quality management that I believe must be emphasized are (1) the assembly and evaluation of basic data on water use, reuse, and quality degradation; and (2) a more vigorous policy of policing and inspection of sewage and industrial waste-controlled installations. I believe that a consistent surveillance of streams is as necessary in safeguarding them as it is promoting safety on highways.

To sum up these brief observations: From many parts of the Ohio Valley, and probably for other similar areas, the problem of assuring adequate water resources for the future is not so much one of quantity deficiency as it is one of preventing quality degradation. By applying more intensively what we already know about removing contamination from used water—and looking forward to the perfection of techniques

for doing this more effectively—we should be able to solve the problem.

To lend support to this conclusion one might look abroad to what has been accomplished in the Ruhr Valley of Germany and by the conservators of the Thames River in England. Here in areas of limited water, the art of quality management has made possible the accommodation of tremendous concentrations of population and industry. What has been accomplished abroad provides inspiration and confidence that similar efforts should accomplish the same thing in the United States.

Thank you, Senator Hart.

Senator HART. Thank you very much, Mr. Cleary. In some parts that was a very peppery statement.

I am sure the committee will consider one of your specific recommendations, the inquiry with respect to the dollar efforts and personnel efforts by the several States.

Of course, that inevitably leads you farther down that road. Let us assume the effort is inadequate and public interest cannot be excited to the point of improving the State effort. Then, of course, the question is presented: have we come to another point in history where the Federal Government moves in? I am sure that will be the subject of much discussion for many years.

Mr. CLEARY. If the local interests cannot do the job, and the job must be done, then other means must be sought.

Senator HART. Those who are zealots in the defense of the rights of the State will be, I hope, equally interested in exciting efforts by the State.

Your general statement will be placed in the record at this point.

STATEMENT BY EDWARD J. CLEARY, EXECUTIVE DIRECTOR AND CHIEF ENGINEER OHIO RIVER VALLEY WATER SANITATION COMMISSION, CINCINNATI, OHIO

SAFEGUARDING WATER RESOURCES THROUGH POLLUTION CONTROL—THE CHALLENGE IN THE OHIO RIVER VALLEY

Mr. Chairman and members of the committee, my name is Edward J. Cleary. I am executive director and chief engineer of the Ohio River Valley Water Sanitation Commission. The commission, an interstate compact agency, was created with the approval of the Congress of the United States.

The commission is an instrumentality of the States of Indiana, Illinois, Ohio, Pennsylvania, New York, Virginia, West Virginia, and Kentucky, each of which is pledged by compact, "faithfully to cooperate in the control of pollution in the waters of the Ohio River Valley." The compact among these eight States was signed by their respective Governors on June 30, 1948.

At the quarterly meeting of the commissioners on September 30, 1959, I was instructed to prepare a statement and offer it for submission to your Senate Select Committee on National Water Resources.

Our commissioners were motivated by a desire to share with your committee the experiences of eight Sates in their regional crusade for clean streams. In particular, they wish to emphasize the fundamental roles of pollution control in safeguarding water resources for present and future demands.

In many parts of the Ohio Valley the problem of maintaining quality of water resources overshadows problems related to quantity. This is not to suggest, however, that there is sufficient quantity of water in all places at all times. In the Wabash, the Scioto and the Mahoning River Basins, for example, the availability of streamflow at certain times leaves something to be desired. And our commission has gone on record in support of multiple-purpose reservoir projects that provide storage for the augmentation of low flows.

Quality Considerations Overshadow Quantity

On the Ohio River, which has been the focus of commission attention, quality considerations take precedence in providing water-resources safeguards now and

for the future. Consider, if you will, a typical situation such as that prevailing at Louisville, Ky. Here the average quantity of flow of the Ohio River is of this magnitude: In the short interval of time for you to take one breath, 3 million gallons of water passes by. In this same period of time the entire population of Loiusville requires less than 3,000 gallons of water; and virtually all of this is returned to the river after purification in a sewage-treatment plant. In other words, the available quantity at Louisville is 1,000 times greater than present requirements.

With regard to water, the principal concern at Louisville—as indeed must be the concern at 115 other municipalities as well as the 81 major industries who depend on the Ohio River for water—is not quantity. The problem here is quality.

Prior to establishment of the eight-State Ohio River Valley. Sanitation Commission, Louisville had reason to be gravely concerned about the quality of its water source. This great interstate river passing Louisville carried the untreated sewage from millions of people, along with the discharges from hundreds of industries. With virtually no control on waste discharge being exerted by those upstream, small wonder that Louisville felt no compulsion to purify its sewage. Thus the quality of the Ohio River was further degraded as it passed from Louisville to those downstream.

However, there is reason today for the citizens of Louisville—and all of its Ohio River community and industrial neighbors upstream and downstream in neighboring States—to believe that progress is being made in safeguarding water resources through a regional program of pollution control.

And the reason stems from knowledge that the eight States who pledged faithfully to cooperate in the control of pollution are redeeming that pledge. Permit me to recite only one aspect of accomplishment resulting from that pledge: When the Commission began its work in 1948 less than 1 percent of the 3,600,000 people living along the banks of the Ohio River provided treatment for its sewage. Today, 95 percent of the population has a treatment plant operating or being readied for operation just as fast as construction contractors can complete them.

Meantime, so far as industrial wastes are concerned, three-quarters of the industries have installed control facilities. Not all of them are adequate to meet ultimate necessities for safeguarding water quality. But it can be said that a majority of industries have now done something to prevent degradation of river quality as contrasted with virtually nothing just a few years ago.

Substantial as this progress in pollution control may be, it is really only the beginning in development of a quality management program in the Ohio Valley to satisfy future water needs. There are certain aspects of the present program with which the commission can hardly concede satisfaction. For example, there has been little success yet in minimizing the discharge of acid water from active and abandoned coal mines in the upper Ohio and its tributaries. Oil pollution continues to be a major source of complaint. The commission also recognizes that much more needs to be done in curbing other discharges that contribute to the formation of tastes in water supplies. And with the more subtle physiological aspects of quality degradation, notably those related to potential toxicity hazards associated with certain wastes, the commission has long been concerned. In fact, as far back as 1950 the commission undertook sponsorship of toxicity evaluation studies at the Kettering Laboratory in the University of Cincinnati Medical School.

Monitor and alert system

Further, there is always the possibility of accidental discharges from industries that may profoundly affect river quality. To cope with such situations, the commission and its signatory States have been pioneering in the development of a monitor and alert system. Already certain elements of such a system are in operation. For example, 47 monitor stations have been established by the commission on the Ohio River and principal tributaries during the past 7 years. Much of this work has been made possible through a happy contractual relationship with the U.S. Geological Survey and with the cooperation of the U.S. Corps of Engineers.

At these monitor stations, the river quality is analyzed routinely for chemical and bacteriological changes. When extraordinary conditions are noted the information is relayed to downstream water supply points so that appropriate adjustment in treatment methods can be anticipated. More recently, a radioactivity monitoring program at some 70 locations was inaugurated in coopera-

tion with the signatory States, the Atomic Energy Commission, the U.S. Public Health Service, and private contractors who operate nuclear-energy facilities.

For the past 3 years the commission has been endeavoring to develop robot monitor stations. These would incorporate equipment for automatically analyzing water quality and would relay the information automatically to our central headquarters in Cincinnati. This concept in river management is new and our enthusiasms are somewhat greater than the progress we have made. But some day we hope to have 24-hour-a-day robot monitors on duty to assist in the task.

This, in brief, summarizes some activities and aspirations of the eight States in meeting the challenge of safeguarding water resources through quality management. Details are contained in annual reports that are made to the Governors of the signatory States. The two most recent reports are attached and form part of this statement.

Experiences and conclusions

Experiences in the Ohio Valley reveal that there are vast opportunities for preservation of the quality of water resources through effective pollution-control practice. In order to realize these opportunities, however, the following conclusions would appear to have validity.

(1) It is unrealistic to assume that the solution to pollution problems is simply a matter of devising legal prohibitions. Laws forbidding the pollution of waters have been on the statute books of our States for scores of years. But progress in securing clean streams has shown little relation to the number or stringency of legal measures designed for this purpose.

(2) Neither is it realistic to believe that progress in expediting water-pollution control must be paced to research effort and the development of further technical knowledge. This does not deny that certain problems command all the research and scientific talent that can be made available. But much pollution could be abated now simply through aggressive application of what we already know. The lack of willingness rather than the lack of know-how is the obstacle to pollution control in many situations.

(3) If we do not lack for laws and technical knowledge, then what is the reason why advancement in pollution control has been so frustrating? The answer, in brief, might be this: To gain acceptance by municipalities and industries of the obligation to control their waste discharge and thus protect the welfare of downstream neighbors is an exercise in social reform. Social reforms are achieved by bringing about a change in public attitudes and values. It is my conclusion that where progress has been made in pollution control it has resulted in large measure by first inspiring public understanding and support.

In this connection we might recall the profound observation of Abraham Lincoln. Talking about the manner in which to achieve changes in a democracy, Mr. Lincoln said: "Public sentiment is everything. With public sentiment nothing can fail; without it nothing can succeed."

This viewpoint, I know, is shared by your chairman, Senator Kerr, with regard to the work of this committee. He has stated, and I quote: "It is my hope that we will be able to make such a dramatic presentation of what is needed to be done that it will lead appropriate authorities to make the necessary decisions."

I believe it is fair to conclude that the relation of pollution control to the preservation of water resources has not yet been adequately dramatized for the American public and their leaders in legislative halls.

4. Considering the fundamental importance of pollution control in obtaining maximum benefits from water resources, as well as the magnitude of the tasks associated with it, State legislatures might well inquire as to the adequacy of funds appropriated for this purpose. It has been traditionally maintained that pollution control is a State responsibility. But it is questionable if even the rudiments of this responsibility can be carried out in any State with a staff of only six people. Yet such actually is the case in one of our growing and rather heavily industrialized States. Other situations of similar disparity between workload and staff would not be difficult to find.

It might serve a useful purpose if this select committee could survey the States and determine how much money and personnel is being devoted to water-pollution control and the nature of the program. Such an evaluation would be unique and could provide the basis for recommendations in expediting progress in this fundamental aspect of safeguarding water quality.

5. This leads to the mention of another deficiency in the conduct of effective pollution control. Because many States are pitifully understaffed they have had to neglect two of the essential elements of water-quality management,

namely: (*a*) The assembly and evaluation of basic data on water use, reuse and quality degradation; and (*b*) the policing and inspection of sewage and industrial-waste control installations; a consistent program of surveillance is as necessary in safeguarding streams as it is in promoting proper use of our highways.

In summary

To sum up these brief observations: For many parts of the Ohio Valley, and probably for other similar areas, the problem of assuring adequate water resources for the future is not so much one of quantity deficiency as it is one of preventing quality degradation. By applying more intensively what we already know about removing contamination from used water—and looking forward to the perfection of techniques for doing this more effectively—we should be able to solve the problem.

To lend support to this conclusion one might look abroad to what has been accomplished in the Ruhr Valley of Germany and by the conservators of the River Thames in England. Here in areas of limited water, the art of quality management has made possible the accommodation of tremendous concentrations of population and industry. What has been accomplished abroad provides inspiration and confidence that similar efforts will succeed in the United States.

Senator HART. I do wish Senator Kerr had been here to meet Dean Fontanna, Dean Stanley Fontanna, the School of Natural Resources of the University of Michigan.

STATEMENT OF STANLEY G. FONTANNA, DEAN, SCHOOL OF NATURAL RESOURCES, UNIVERSITY OF MICHIGAN

Mr. FONTANNA. Senator Hart. Probably we hear more talk at these hearings about what we need to accomplish than we do about the fact that we need to really gather the material to do these things which are needed.

I have not any question, Senator Hart, that as these hearings have swung around the country, that there have been expressions from time to time relative to the relationship of the forests to the water, particularly in the areas of slope.

My purpose this morning is to bring to your attention that two programs of research, both having Federal overtones, one particularly in relation to forests-water relationships—these programs that I speak of that pretty generally you hear about relate themselves largely to surface waters and to runoffs and the effect that the forests may have on these particular things.

Here in the State of Michigan we have a rather unique situation in our northern forested area where the regime of the streams and lakes in that area are affected not particularly by runoff but rather by ground water. In other words, with the forest cover that is present and with the absence of slope our ground waters are the support of our streams and lakes.

Now, we have here then an ideal situation for studies into forest-ground water relationships because we are dealing directly with the transfer of waters from the forest floor into the ground waters and directly from the ground waters into the streams and lakes.

We have in the State of Michigan a very modest program of research. I think the Senator is somewhat acquainted with this thing. It is conducted by the U.S. Forest Service, which is the Federal agency which does largely this type of research where forests-water relationship is involved.

We think that what we can learn from our research in this particular area will bring forth something new in ground-water relationships which we simply have not had researched in various other areas.

I would also like to bring to the attention of the committee the fact that we can influence the amounts of water going into streams by varying the composition of the vegetation just exactly as is done in the Western and Southwestern States with reference to the influence of the variation of management, of course, on runoff waters. Here I am talking about what we can do to affect ground waters.

Michigan is a recreation State. This is particularly true in our upper part of our State. We are very, very proud of our streams. We are very proud of our lakes, yet we have difficulties of low waters at times in both our lakes and streams.

I have said that these are fed directly by ground waters. We know that we can vary the type of vegetation by forced management so that we can get more water into these streams via the spring supply. In other words, by varying the type of management of our forests we can supply in the spring at the time that the waters are fed into the ground-water recharge, we can actually supply more water to the management of forests and other vegetation on the ground.

I want to repeat, Senator, that this program that we are undertaking—I say "we" because this is a joint program of the U.S. Forest Service and the State department of conservation, the University of Michigan is thrown in somewhat, and I think that this is the program which can well stand some amplification. So much for that very modest program.

My second plea goes to the matter of research in the Great Lakes. Everybody that gets up and talks about water supply and waterways and what have you invariably gets to the Great Lakes. Now, the Great Lakes are useful to the State, to the lake States and to the Federal Government, not only in the matter of water supplies and waste disposal, but they have some slight influence on the matters of navigation and commerce.

One of the remarkable things about the Great Lakes is the tremendous lack of knowledge of the waters of the Great Lakes. This is truly remarkable.

Just exactly why it is so I would not know. But it is a matter of fact that the amount of research into the various aspects of the waters of the Great Lakes has been very, very minimal. It has been attacked spasmodically by State agencies, and by Federal agencies and by the Canadian Government, but only spasmodically and on a very, very small scale.

Now I speak particularly here today for an agency of the University of Michigan which is called the Great Lakes Research Institute, formulated in 1956. It has already done some tremendously effective studies in the waters of the Great Lakes. Yet this institute is operating on a token budget augmented somewhat by grants from foundations.

Some plea has been made to the State for appropriation of funds. Unfortunately these have—while we had the most sympathetic consideration by the legislature, these pleas have come during a period of, shall we say, financial stringency in the State.

Now, this is a Federal hearing. I have been talking about a State institution and the financing of that institution, but I would like to put before the committee that this is not strictly a State matter or a matter of the States of the Great Lakes. This is a waterway which is now a waterway of commerce, not only for the United States but for other countries.

Just a little bit of an example, what do we actually know about the currents in the Great Lakes? We know very, very little and yet these are things that definitely affect navigation on the Great Lakes.

What work has been done has been done fortunately in combination with all the various and sundry agencies, Federal agencies, U.S. Fish and Wildlife Service, the Corps of Engineers, the U.S. Public Health Service, with the Canadian Government, the Province of Ontario, with the other States, but putting all these things together we have so little it is just too bad.

My purpose in appearing here today on this particular program is simply to bring to the attention of the committee the tremendous lack of information that we have in this very, very important area.

I thank you.

Senator HART. Dean?

Mr. FONTANNA. Yes?

Senator HART. The information on the profile of the lakes is complete, am I not right on that?

Mr. FONTANNA. Yes.

We have almost no biological information. We have little current information. We have practically no water quality information. These things are—such problems as the matter of water supply, as a matter of sewage disposal. We put water in the Great Lakes. We do not know exactly what is going to happen when we put waste in there. We do not know what is going to happen. We do not have enough knowledge of the waters themselves to know what is going to happen. There is the question of commercial fisheries. The Great Lakes are very important matters here in the Great Lakes. Yet the biological aspects of the lakes themselves, the amount of food that is furnished for fishes and so forth and so—there is very, very little knowledge.

And very little funds that have been forthcoming from any source. I think the Canadian Government has done better in this regard than we have. But I assure you that when you put it all together it is very, very small.

Senator HART. I was struck during the debate on the Chicago diversion on the Senate side this spring that the most recent chart indicative of what would happen with the discharge back into Lake Michigan, out of Chicago, bore the date of 1901 or 1903. I do remember that.

I can speak only as a local boy on this. I will be very glad to see if I can impress the others on the committee with the desirability of expanding our knowledge generally about this very great resource.

Mr. FONTANNA. I do not have any specific suggestions, Senator. I do know that many Federal agencies are working in their own way. I think that if you address any one of them they will say "I just haven't too much to work with." Our problem here as far as the State is concerned is to present it to the legislature and try to emphasize it suffi-

ciently so that we can do our part, but I think that you will find the Federal part also needs some augmentation.

Senator HART. It is just conceivable that with increased usage we will discover that the lakes are an even greater asset than we thought that they were.

Mr. FONTANNA. Yes, sir.

Senator HART. Or that we are badly wasting an asset.

Mr. FONTANNA. Thank you.

Senator HART. Thanks very much.

Mr. FONTANNA. Thank you.

(The prepared statement of Mr. Fontanna follows:)

STATEMENT OF STANLEY G. FONTANNA, DEAN, SCHOOL OF NATURAL RESOURCES, UNIVERSITY OF MICHIGAN

My name is Stanley G. Fontanna, dean of the School of Natural Resources of the University of Michigan. My purpose in addressing the committee is to describe two programs of research, the objective of which is to gather factual information needed in seeking the answers to some phases of the questions the committee has posed. Since my statement relative to each program is quite brief, I would like to read it.

PART I. HYDROLOGIC RESEARCH IN NORTHERN MICHIGAN

In Michigan's northern forested region the deep mantle of glacial drift which covers most of the area creates a vast region in which runoff from the surface is of only minor importance. Levels of streamflow and the water level in lakes and bogs are directly influenced by the ground water levels existing under the readily permeable soil layers. Between surface water features there are large areas in which all water movement is below the ground surface. The remarkable regularity of the flow of streams and rivers in this area is due to the governing action of this ground water contribution to streamflow.

Most of the emphasis of past research in forest influences on water yield and watershed management has been directed toward the surface runoff factor. The basic relationships between vegetative cover and runoff stages, erosion, and sedimentation are being demonstrated in many areas. Currently, recognition of the importance of subsurface water to both water yield and water regulation is promoting new phases of study into this apsect of water movement. In northern Michigan where the surface water is most directly the result of ground water conditions, the opportunity to study the effects of forests on ground water and of ground water on lakes and streams is available in its most simple form.

In view of our current lack of knowledge concerning the hydrology of ground water and the influences of land management on these processes, the forested regions of the northern portion of Michigan seems to be the ideal location in which to investigate these relationships. Such relationships which exist here in a region where the ground water processes have the maximum influence on surface waters can aid other regions in the interpretation of ground water effects where such effects are masked by surface runoff.

Even though this area approaches the ideal in a hydrologic sense, there are increasing indications that problems of water use are involved. These problems stem from the rapid change in vegetative cover which is taking place .

Following widespread attempts at farming, much of the land has been restored to some type of forest cover by either natural means or by forest plantings. At the present time we are in the midst of this transition. Changes in the vegetative cover on land is known to affect surface runoff. The influences of such cover changes on ground water levels is not yet known. We have data which shows that these ground water reservoirs are recharged during the period of spring melting of winter snowpacks. The amount of water retained in the snowpack is governed, in part, by the type and distribution of the vegetation on an area. The effects of increasing forest area, and of forest management practices on these forests, with the resultant changes in ground water levels will have its most immediate effect on recreational uses of surface waters.

Reduced ground water levels may reduce streamflow in late summer to the extent that water temperatures become too high for trout survival. Forest

cuttings which increase snow water and ground water recharge can be expected to increase average seasonal stream levels and thus improve trout habitat.

Forest stands in areas of shallow water tables, where tree roots are in the ground water, allow the trees to transpire water in excess of their physiological requirements. Reducing the density of these stands may lessen the rate of seasonal decline of water tables at the source of many streams, thus increasing late summer flow. Fluctuations of the shorelines of many lakes having heavy recreational development may be improved by forestry practices keyed to regulation of ground water levels.

Thees are a few of the more immediate results which would be desirable to recreational users. These improvements must come through an understanding of the interrelationships of land management, particularly forest management, and water behavior in this ground water area.

Currently in Michigan a limited scale study has been initiated by the U.S. Forest Service and the Michigan Conservation Department cooperating, to determine the ground water processes and the forests' influence in this region. The problems are nebulous and involve the development of many new techniques to measure the processes concerned and the results derived. In view of both the local and general applications of the information this type of study will yield, I consider it worthy of continued and increased support.

PART II. GREAT LAKES RESEARCH

The second program of research I would like to present to the committee is an area of research in which some very effective work has been accomplished but one in which a tremendous amount remains to be done. I am speaking of the waters of the Great Lakes which serve so importantly in the matters of commerce, water supply, waste disopsal, recreation, and commercial fishing. The completion of the St. Lawrence Seaway only serves to increase this importance and to intensify many of the problems already presented.

Great Lakes research programs include such matters as determination of currents, study of under-lake sediments, the productivity of the waters, water quality, waste dispersion and pollution, shore erosion problems, fish food organisms and the factors regulating their distribution, water transport, lake levels, chemistry and physics of water, and meteorology over the lakes. The results of such research studies can be of major benefit to navigation, to municipalities and industries using the lakes for water supply and waste disposal, to the construction of harbors and channels, to the prevention of beach erosion, to recreation, to fishing, both sport and commercial, and to the training of students in oceanography.

The Great Lakes Research Institute of the University of Michigan is one of the most active agencies doing work of this kind, yet it operates on a token budget from the university, augmented by some National Science Foundation grants to individual staff members. The institute works closely with such State agencies as the Michigan Department of Conservation and the Michigan Water Resources Commission, with such Federal agencies as the Fish and Wildlife Service, the Corps of Engineers, the U.S. Public Health Service and the U.S. Geological Survey, and with the Department of Lands and Waters of the Province of Ontario, so that there is good correlation of work programs. The institute has been in operation since 1956 and despite its small working budget, has already produced and published the results of some very important studies.

Requests to the legislature for special State appropriations to widen the scope of the work of the institute have been made annually and have received sympathetic consideration but no appropriations have been forthcoming, due no doubt to the condition of State finances.

The point I would like to leave with the committee is that the total of all research programs presently in operation in the Great Lakes in effect merely scratches the surface of the need. The importance of this work to the Lake States and the Federal Government merits far greater State and Federal support than it is receiving.

Senator HART. Dr. Stanley Cain. Is Professor Cain here?

Mr. VELZ. I do not think he is here, Senator.

Senator HART. I think Dr. Velz is here, is he not?

Mr. VELZ. We do not have any additional statement to make other than I sent you, Senator. I think perhaps the official agencies are pressed to get their formal statements in.

Senator HART. Doctor, we will be glad to add to the record Dr. Cain's statement, if it is submitted and also your very interesting document that the committee had made available to it earlier.

Mr. VELZ. I might add, that if the committee feels that they are interested in the detailed study which we are making on all of the streams of Michigan in terms of the findings below flow characteristics, this will be probably available before the close of this fiscal year.

This would consummate a 5-year intensive study that we made in cooperation with the Michigan Water Resources Commission through the university.

Senator HART. We would certainly appreciate receipt of that study when completed. I will ask that your article that appeared in the Journal of Public Health on the integrated water resources use and development be made a part of the record.

(The information referred to follows:)

STATEMENT OF C. J. VELZ, CHAIRMAN, DEPARTMENT OF ENVIRONMENTAL HEALTH

OCTOBER 16, 1959.

HON. PHILIP A. HART,
Senator from Michigan,
Senate Office Building, Washington, D.C.

DEAR SENATOR HART: In response to your kind letter of September 29, I am enclosing herewith a reprint, "Integrated Water Resources Use and Development," which appeared in the December 1958 issue of the American Journal of Public Health, and which you may find helpful in consideration of water resources development policies. In our experience in researches and service to industry and government in dealing with water supply and waste disposal problems it is increasingly apparent that as competition for limited water resources intensifies, piecemeal solution will not resolve the many pressing water problems in both arid and humid regions of the United States. Narrow development for single purpose, public or private, without regard to other water uses in a drainage basin results not only in inefficient use of the resource but in conflicts whereby the efforts of one agency undo the accomplishment of another agency. Therefore, the primary objective should be an integrated approach to water resource development, giving consideration to multiple use.

If we are to keep pace with the growth of a technological urban society more attention must be given to development of our water resources, particularly in making available a larger proportion of the total annual flow through low flow regulation. In many areas, community and industrial development is now definitely restricted to the minimum flows that occur during drought periods, and in my judgment, as we look to future needs, it is imperative that drought stream control be given the high priority that has long been accorded flood control.

Storage of flood waters with release during the dry weather season to augment low flow can be developed for multiple purpose and results in broad benefits in assuring community and industrial water supply, satisfactory and economical sewage and waste disposal, adequate water supply for steam and nuclear power generation, supplemental irrigation, and recreational needs. Not all of these benefits can be entirely represented in terms of dollar value, assessable to a specific beneficiary. Consequently, part of the cost might well be considered in the broad general public interest, supported by Federal appropriation.

If it is deemed desirable to document the severity of drought conditions in the north central region, we have prepared for the Michigan Water Resources Commission a detailed study of the low-flow characteristics of streams throughout the State of Michigan. It is anticipated that the report will be published within the fiscal year. We have also made detailed studies of a considerable number of streams in Indiana and Ohio which I would be glad to make available in summary form.

In our researches, we have also carried out detailed studies on the cost of sewage treatment works, particularly for the north central and northeastern region. These cost analyses are based upon demonstrated practice, employing bid prices or contract costs of works. These data afford a basis for evaluating pollution alleviation benefits associated with low flow regulation and also afford a basis for appraising the damages associated with water uses conflicting with or destroying natural waste assimilation capacity of streams. If you desire, I would be very glad to make available to the committee the detailed information developed in these researches.

Sincerely yours,

C. J. VELZ,
Chairman, Department of Environmental Health.

INTEGRATED WATER RESOURCES USE AND DEVELOPMENT

(By C. J. Velz,[1] C.E., M.S.P.H., F.A.P.H.A.)

The No. 1 resource problem in the country today is water. Interest in water resources is not for the sake of water but for the sake of people, who must use it. The economic and social structure of whole regions depend upon available water resources and how these are used and developed. The free world is in a technological race, and estimates point to a doubling of industrial production in 15 to 25 years. Paralleling industrial expansion is an unprecedented population growth with an accelerated trend from rural to urban living, spilling over political boundary lines into complex, industrial-urban corridors. If the free world is to meet these demands and is to keep pace with intensified technological urban growth, increased attention will have to be given to water resources development and use. Already in many areas acute water problems and rivalries break into the headlines of the newspapers. It is increasingly apparent to the public that all is not well, and questions are being raised concerning the competency of existing agencies to deal effectively with the situation. Unless some present wasteful practices are changed and a new and broader view is taken with respect to water resources development, communities and their industries are going to find themselves tightly boxed in with regard to possibilities for expansion and growth.

More is involved than a community water supply and a community sewage disposal system. Seldom is a city alone on a river; someone else is either above it or below it, and what you, they, or some governmental agency may do with water resources has an impact upon other water users. As the industrial-urban complex grows, competition for limited water resources intensifies and the multiple water uses—community and industrial supply, hydro, steam, and atomic power, flood control, navigation, irrigation, recreation, fishing, and the inevitable necessity of sewage and waste disposal—become more and more inextricably interrelated, calling for an integrated approach.

In this brief presentation, I wish at least to provoke a critical view of the water problem and a consideration of some new approaches which appear to hold good prospects of meeting the pressing water needs of the future. Before looking forward, an objective review of past practices is in order, and then I shall turn to a river basin case history, the grassroots approach developing in the Kalamazoo River Valley of Michigan.

There has been a growing tendency toward centralization of water resources development in Federal agencies, principally in the Department of Agriculture, the Bureau of Reclamation, and the Corps of Engineers, with less and less initiative by State and local governments. The Federal trend has been toward large-scale projects, to the neglect of many smaller drainage basins. Emphasis has been upon four principal aspects—flood control, navigation, hydro power, and irrigation—with little thought to other water uses. Almost no consideration has been given to providing an assured streamflow for community-industry's expanding needs or to the key problem of satisfactory sewage and waste disposal. With a few outstanding exceptions, State and local interests have

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not actively participated in shaping Federal water policy, nor have they organized and taken initiative in developing a water policy of their own.

As a result, development of water resources has been largely on a piecemeal basis—each water use considered pretty much as an isolated problem independent of all other uses in the basin. In many instances a disaster, such as a dramatic flood, has dictated a one-sided view; development has been centered on flood control, with inadequate consideration of the overall water needs, and at times actually to the detriment of other water users. In other instances, special interests, public or private, dominate, and a single-minded development, such as large-scale navigation works, proceeds on a narrow basis, often with serious loss of natural self-purification capacity. Or hydro power is oriented to the serving of peak power demands, inducing radical fluctuations in stream discharge, with little or no flow permitted to pass downstream on offpeak periods. Frequently such operating practice involves a 2- to 3-day shutdown on weekends. Cutting off the river for 2 or more days each week is not very helpful to downstream users. The utility industry appears to be unaware that, paradoxically, on the one hand, it is spending substantial sums on promotion to attract new industry and encourage community growth in service areas; but, on the other hand, is making it virtually impossible, in the operation of hydro and steam plants, for industry to locate in the river valley. Such piecemeal, one-sided development results in waste of precious water resources and inevitably leads to chaotic water policy.

Public health agencies assigned major powers and responsibilities to deal with community and industrial water supply and waste disposal have, possibly unwittingly, fostered further fractionalization and piecemeal development. The two interrelated phases of the water contact cycle have been split as though they were independent; incoming water supply is dealt with largely as a problem separate from that of the outgoing waste water return. Incoming supply has received the major attention, but often the responsibility to consider adequately at the same time the satisfactory disposal of the spent water supply—the waste water returned to the stream—has received scant or at best belated attention.

In turn, each of these two phases has been further fractionalized. In many instances community water supply has been planned and developed on a narrow basis, leaving industries and rapidly expanding fringes outside the central political unit to fend for themselves. Hodgepodge water supply systems result to the detriment of community and industrial growth. The water supply of Metropolitan Philadelphia comprises some 100 separate systems serving 163 political units, with hundreds of independent industrial supplies. Similarly, the Buffalo-Niagara Falls urban-industrial corridor comprises some 50 separate systems, and the Greater Detroit metropolitan region involves some 33 separate systems with many independent industrial supplies. True, there are examples of integrated supply systems such as Boston and on the west coast, but these are the exception rather than the rule.

Similarly, disposal of the spent water supply has been fractionalized. In many instances industrial waste has been considered as a problem separate from that of community sewage disposal. In fact, some agencies and cities have gone so far as to discourage or deliberately forbid admission of industrial wastes to the municipal system. Perhaps this approach reflects an archaic concept that the only problem in pollution control is to protect the community against communicable disease; hence, if only the sewage has been treated, all's well and the health department's responsibility has been met. Responsibility goes far beyond this in an industrial-urban age. To encompass the entire waste disposal problem assuredly means protection against disease, but more than that, it means insuring quantity as well as quality of water—not just drinking water, but water in all its uses conducive to optimum living.

Regulatory agencies with but few exceptions have been depending almost exclusively upon sewage and waste treatment as the cure-all for pollution prevention and abatement. It is increasingly apparent that recovery and treatment of wastes afford only a partial answer. There is no such thing as 100 percent treatment or recovery; technical and economic limitations inevitably result in a situation where some fraction of the waste must ultimately be handled by natural purification in the water course. Thus it is axiomatic that in an urban-industrial society, some end products must be handled by the water course.

As a gift of nature, each water course has its unique natural purification capacity, which constitutes an invaluable water resource asset. This asset should and

must be utilized. Relatively, the quantity of water required for incoming water supply is much smaller than the magnitude of streamflow required for satisfactory disposal of sewage and waste effluents. The key to satisfactory waste disposal, therefore, is a quantitative determination of the waste assimilation capacity of supply is much small than the magnitude of streamflow required for satisfactory disposal of sewage and waste effluents. The key to satisfactory waste disposal, therefore, is a quantitative determination of the waste assimilation capacity of the stream along its course under reasonable probabilities of the low streamflow expected. It is fair to say that major effort has not been devoted to this quantitative evaluation. Rather, treatment requirements and design of works have been somewhat arbitrarily arrived at. The result usually is either too little or too much treatment. Without a rational basis for design, there has been an alarming tendency to add many costly features to works which do not remove waste load and are ineffective in protecting the stream. Society cannot afford the luxury of expensive monuments along the banks of rivers unrelated to the real capacities of the stream or to the water use requirements placed upon it.

There is an increasing number of situations where the "treatment alone" philosophy has reached the end of the road. While the city of Dayton now has so-called complete treatment, in the Miami basin urban-industrial corridor, the residual effluent load, in combination with adverse effects of other uses of the river, results in serious dissolved-oxygen depletion approaching exhaustion during the dry weather and drought periods. In the headwaters, treatment of community and industrial waste by trickling filters, followed by activated sludge, is inadequate to protect against dissolved-oxygen exhaustion of the receiving stream during the drought season. Treatment will always play an important role in satisfactory waste disposal but clearly it has limitations, and other approaches are essential if industrial and urban growth is to continue.

It also can be fairly said again that with a few outstanding exceptions, there is a conspicuous vacuum in leadership and initiative at the State and local levels in representing the water needs of the community and of industry when plans for other water resource developments are under consideration, particularly the proposals of Federal agencies and large utilities. Depending upon how they are planned and operated, manmade river developments can be either detrimental or beneficial to community-industry water uses, especially as they concern the difficult problem of waste disposal. Each river developer, whether for power, navigation, irrigation, flood control, or some other use, acts as though in a hermetically sealed cell without too much thought of the impact of his project upon other water users. Whose responsibility is it to be on the alert to see that adverse effects of a project are eliminated or minimized and that, where feasible, beneficial multipurpose features are included?

On one large coastal river, a Federal agency is proposing to divert the entire fresh waterflow around a busy harbor for the avowed purpose of saving dredging expense. If constructed, the diversion would be disastrous from the standpoint of community and industrial waste disposal. On a large southern river, a Federal flood control and hydro development project is being constructed which, if a small regulating reservoir were included, could eliminate diurnal and weekend fluctuations in discharge induced by hydro operation and could make available from the large upland storage an assured dry weather flow three times that attainable under the present plan. These examples illustrate the need to evaluate the impact of one use upon another and the need to take action at the planning stage—once constructed, it is too late.

Further critical evaluation of past practices only emphasizes the folly of a piecemeal approach to water resources use and development. As we face the increasing demands for water from future urban-industrial growth, hope lies in a broader view, and perhaps, with better understanding of the interrelation among uses, the benefits of an integrated approach will be realizable. There are encouraging signs of change, evidenced by responsible local leadership and pooling of special interests, toward planning more orderly water resources development on an integrated basis.

One of the most promising means of alleviating many acute water problems and of providing an increment for future expansion is drought control through low flow regulation. An exasperating aspect of water as a natural resource is its dynamic character. There is no assurance of a fixed definite quantity, as in the case of a static mineral resource. Water is a variable, and in making use of it in the natural setting, one is always at the mercy of chance occurrence. In addition to very unequal geographical distribution of streamflow, the quantity tomorrow will be different from that of today, varying through the seasons and

from year to year with extremes of flood and drought. While the average flow of a river may appear good, the real restriction limiting community and industrial growth is the uncontrolled natural drought flow. The threat of drought is a constant overshadowing factor but at times is unwisely not recognized or is ignored. Following the chance occurrence of a succession of wet years, the temptation is to expand community and industrial development beyond a reasonable risk, only to find during dry years, which are certain to occur, insufficient water to support that expansion. This is the nature of the variability and insecurity of water resources in the natural setting.

There is an alternative to living within the restricting framework of natural drought variations—that is, drought control through low flow regulation. Excess water during flood season is stored for release during the dry, warm-weather season thereby assuring a dependable streamflow several times greater than that obtainable under conditions of uncontrolled drought yield. This minimizes the risk of water shortage, eases the burden of waste disposal, and permits a much higher level of community and industrial growth. Low flow regulation is not entirely a new concept; what is new is a grassroots approach, with local community and industry initiative, in water resources development.

Let us now turn to the Kalamazoo River Basin, which typically reflects the shortcomings of past piecemeal development, the impact of one conflicting water use or development upon another, and exhibits a bright ray of hope for the future.

The Kalamazoo basin, comprising some 2,000 square miles, is roughly 100 miles long by 20 miles wide, draining into Lake Michigan. The basin lies wholly within the State of Michigan and is in the path of the rapidly expanding Detroit-Chicago industrial-urban corridor. The major cities are Kalamazoo, the home of the world's largest paper de-inking concentration, and Battle Creek, the home of the great Kellogg and Post breakfast food industry.

Early river development centered on navigation, followed by a series of 15 small run-of-the-river hydro powerplants, later augmented by 6 steam power stations. As early as 1930, community and industrial growth created stream pollution problems, particularly during the dry weather season. By 1945 the situation was acute, aggravated by the fact that pools behind dams were slowing the time of passage and accumulating deposits; steam powerplants were increasing the river temperature and hydropower was inducing radical fluctuations in steamflow. Under the leadership of the State water resources commission, municipalities and industries had taken a first step toward pollution alleviation through process changes and treatment works at a cost to date of upward of $7.5 million. In the past 10 years, however, expansion and increased production have continued apace, and today, notwithstanding all efforts, the river is in critical condition. Treatment alone is not the answer—not even so-called complete treatment will meet stream requirements, so that the outlook for future growth in the valley is indeed dismal under conditions of uncontrolled drought streamflow. And then, to further illustrate the folly of a piecemeal approach, a Federal agency, stimulated by the 1947 spring flood, proposed local flood protection works which, if constructed, would virtually negate the efforts expended for the alleviation of pollution.

In the sense of living within the framework of the expected natural drought pattern, the Kalamazoo Valley has already overexpanded. The only hope for the valley is more water down the river, which is feasible only by drought control through low flow regulation. Intelligent leadership in the valley recognizes this and is ready to abandon the piecemeal approach for a more rational integrated development. Recently, work began quietly in this direction. In the past, with Michigan's flat topography, reservoir sites had been assumed to be nonexistent. However, it was decided to take a new look, and a systematic search was rewarded by a rather dramatic possibility for a multiple-purpose development in the headwaters.

Preliminary study indicates the feasibility of a reservoir of about 18 square miles which will assure a streamflow three times the drought yield in the lower river to six times in the upper reaches. The site is directly in line with migratory duck flight and is ideal for duck nesting. After mid-May or the first of June, when fledglings are on their own, the water is available for augmenting the summer-fall low streamflow. Recreational possibilities may also be realized by stabilizing several smaller lakes or, easily, through segregation of a portion of the reservoir for sport fishing, bathing, boating, and resort development. Flood hazard in the valley is not a matter of loss of human life, and it appears that some alleviation can also be provided from the available reservoir storage. With the reservoir located in the headwaters, low flow regulation benefits all

users along the entire river course—the hydropower, the steam power, the ground and surface water supplies, recreation—and, of course, it provides a substantial increment to the stream's waste assimilation capacity.

Perhaps the most important aspect of the integrated approach to water resources development is the opportunity it affords for future growth in the valley. Removing the restricting pinch of uncontrolled drought and increasing dry-weather streamflow severalfold profoundly changes the social and economic outlook, not only in the areas of existing community-industry concentration, but because entirely new reaches of the river would be opened for industrial sites and other developments.

With the encouragement of the State water resources commission and the State conservation department, the plan has been presented to several groups of civic and industrial leaders of the valley, where it has been enthusiastically received. There is no precedent for this type of grassroots approach toward integrated water resources development. Much work remains to bring the plan to practical realization. In addition to technical, legal, and economic aspects, public education and public relations necessary to successful local initiative are recognized as essential to fruition of the plan.

Thus far, certain basic premises seem to prevail. These are: (1) an intelligent appreciation of the importance of water to the economic and social life of the valley, with recognition of long-range as well as immediate problems; (2) a strong desire for and pride in local initiative; (3) a willingness of special groups with vital stakes involved to pool their special interests in an integrated approach; and (4) a willingness to share the cost locally.

The Kalamazoo Valley is a promising pilot development to watch. It may prove to be the pioneer in a new national pattern of integrated water resources development with a resurgence of local action.

The challenge to consider the water problem as a whole on an integrated basis is squarely before the public health profession. Traditionally, society has delegated major responsibilities for water in very broad terms to the health agencies. Let us hope that by vision and action this public trust will justifiably be continued.

Senator HART. Again I appreciate the University of Michigan's contribution.

Speaking for the Great Lakes Commission, Marvin Fast.

STATEMENT OF MARVIN FAST, REPRESENTATIVE, THE GREAT LAKES COMMISSION

Mr. FAST. Senator Hart and Congressman O'Hara, it is a real pleasure to be here with you this morning. I have submitted a prepared statement on behalf of the Commission. I request that that be made a part of the record.

Senator HART. It will be in full.

(The prepared statement referred to follows:)

STATEMENT BY THE GREAT LAKES COMMISSION

This statement addresses itself to a single water resource—the Great Lakes—and summarizes what the Great Lakes Commission considers the major needs and problems in the further development and management of this resource.

Because of the importance nationally of the water resources of the Great Lakes and their navigable, interstate, and international nature, the Federal Government properly has assumed important responsibilities for their development. Of special significance is the Federal role in providing navigation improvements, both for commercial and recreational purposes; its leadership and financial support in lamprey control and fishery research programs; its continuing supervision of pollution control in the boundary waters of the St. Marys River and in the Detroit and the Niagara frontier areas through the International Joint Commission's boards of control; its regulation of the levels of Lake Superior and Lake Ontario and of the flow at Niagara Falls through similar instrumentalities; the development or licensing of hydroelectric power projects on the St. Marys, Niagara, and St. Lawrence Rivers; and its activities

pertaining to the protection of the Great Lakes beaches from erosion and inundation.

At the same time State governments on the Great Lakes and their subdivisions have retained and assumed important responsibilities in the development and management of the Great Lakes. Development of the lakes as the source of water supplies, control over pollution discharged into the lakes, regulation of and research on the fisheries, control of shoreline uses and development of recreational facilities along the lake shores, and construction of port facilities, hydroelectric projects and beach protection works are among the significant programs undertaken by State and local governments.

This statement throughout is directed primarily toward the role of the Federal Government. While such is the case, we wish at the outset to make clear our recognition of the rights, duties, and opportunities of State governments, and their subdivisions, in further developing and supervising this resource. These, while not emphasized here, are this Commission's continuing concern in its program as a joint agency of the States.

Reaching more than 2,000 miles or almost halfway across the North American Continent and embracing vast areas in two countries, the Great Lakes-St. Lawrence River system drains an area of some 325,000 square miles. The Great Lakes themselves, with a water-surface area of over 95,000 square miles, are a series of connected natural reservoirs for the runoff of the precipitation of an area of about 200,000 square miles, a precipitation that averages approximately 31 inches annually over the entire basin. This vast amount of water is, in effect, stored in this series of reservoirs, which absorb variations in the precipitation supply through a range in stage of about 5 feet. An indication of the vast amount of water available in these "reservoir lakes" is suggested by the ratio of the land area in the Great Lakes Basin to the water area of the lakes, a ratio roughly 2 to 1. It also is indicated by the average discharge of water from the Great Lakes into the St. Lawrence River of approximately 240,000 cubic feet per second.

Not only do these reservoirs provide an enormous supply of high-quality water, but they also offer all of water's other beneficial uses. The immensity of the water supply and its flowing characteristics makes it invaluable for the dilution of the effluent of domestic and industrial wastes. With channel improvements at only a relatively few points, it has become an inland waterway and water link to the oceans unrivaled elsewhere in the world and capable of carrying a commerce whose benefits are felt by every person in the Nation. Its tremendous and amazingly uniform outflow makes possible hydroelectric developments at Niagara and on the St. Lawrence among the largest in the world. The waters of the Great Lakes and their shores, further, provide a vast fishing, hunting, and recreation area intensively utilized by millions of citizens. Its fisheries also provide the basis for a productive commercial fishing industry.

A basic conclusion is that as one looks forward into the future and to the water needs of 1980 or 2000 in the Great Lakes this country possesses one of its greatest natural resources—a resource that has not yet seen realization of its full potential of beneficial uses, but is certain to do so increasingly as the requirements for water continue to grow.

A second conclusion is that the objectives of State and Federal governmental policies and programs as they relate to this resource should be to provide improvements needed to realize the full potential which the Great Lakes offer; and, second, to establish programs which will insure sound and efficient management of these waters.

It is to these two points that the balance of this statement addresses itself. As already stated, we limit ourselves here to the role of the Federal Government, in cooperation with the States, in accomplishing these two objectives.

As one looks forward to 1980 and beyond, what, then, are the needs and problems in the further development of the water resources of the Great Lakes and in their management which call for Federal assistance? We suggest that these needs and problems fall under five headings:

1. Assistance to the States in their responsibilities for maintaining the high quality of the waters of the Great Lakes.

2. Measures seeking to achieve a greater degree of regulation over the fluctuating levels of the Great Lakes.

3. Programs to maximize the potential of the Great Lakes and St. Lawrence system for navigation and commerce.

4. Measures to rehabilitate and improve the fisheries of the Great Lakes.

5. Programs which will increase our knowledge about the waters of the Great Lakes.

Assistance to the States in their responsibilities for maintaining the high quality of the waters of the Great Lakes

Recent figures issued by the Public Health Service report that the water needs of approximately 14 million persons in this country, or about 60 percent of the U.S. population residing within the Great Lakes watershed are derived from public supplies taken directly from the Great Lakes. The importance of protecting these supplies for domestic needs—and for industrial use, recreation, and fisheries—is obvious.

Public Health Service data also indicates that the effluent from places serving somewhere between 8.5 and 9 million people is discharged directly into the Great Lakes, with a population equivalent in that discharge being about 4.5 million. This, of course, does not include wastes carried into the lakes by tributary streams and industrial wastes discharged directly into the lakes from numerous shorefront plants.

While, fortunately, the Great Lakes waters are not in the serious condition characterizing some other inland waters, evidence of the danger of increasing and more serious pollution is present. This evidence includes taste and odor problems in certain municipal water supplies due to industrial wastes and algae problems. It also includes injury to the fisheries in certain waters of the Great Lakes, damage to waterfowl from occasional oil pollution, and periodic nuisances and dangerous conditions on some lake beaches from the same source and from inadequately treated domestic wastes. Mention should be made, too, of indications that the submerged lands of the Great Lakes may contain substantial petroleum resources. Exploitation of such reserves clearly poses serious pollution dangers and must be regulated carefully.

This evidence clearly must be recognized as a warning of the need for vigilance. That problems will become more rather than less acute is obvious when the present, and imminently larger, expansion of population and further development of industry bound to occur along the Great Lakes is taken into consideration.

Turning to specific needs in pollution control, the first clearly is that municipalities and industries must improve the treatment of wastes they discharge into the Great Lakes. This is primarily a local and State responsibility. We also emphasize, however, the importance of the various forms of Federal assistance administered by the Public Health Service directly and, in the international boundary waters of the Great Lakes, by the International Joint Commission. Continued and expanded support of these programs is essential.

Adequate pollution control requires not only the provision of dependable volumes of water for dilution of the effluent but also the means for ridding the effluent, before it is discharged, of foreign substances—chemicals, detergents, salts, insecticides and other contaminants—which seriously affect water quality. Unfortunately present methods for treating pollution cannot effectively cope with many of these substances, and as a result thousands of tons are discharged daily into waters which cannot purify and assimilate these wastes.

An urgent need therefore is an expanded program of research on improved means for treatment and disposal of industrial and other wastes which presently known methods and technology are unable to purify to the degree necessary for preservation of water quality. This of course is most urgent in the case of smaller inland bodies of water, in the Great Lakes region and elsewhere, lacking the waste-absorbing capacity of the Great Lakes waters. But the increasing amounts of such wastes finding their way into the Great Lakes almost must be a matter of concern, and we recommend therefore that Congress provide the appropriations necessary for an expanded and cooperative Federal-State program to develop improved means for treating wastes not treated, or only partially treated, by presently available methods. We are advised by sanitary engineers that, at the minimum, appropriations for such research should total several million dollars in the first year of an intensive 5- to 10-year effort. Such a program seems of equal importance to the present Federal program in desalinization research and should be accorded a comparable priority.

A second important need is for an expanded attack on the difficult problems in dealing with pollution resulting from increased shipping and recreational boating on the Great Lakes. Here again we emphasize that this is not exclusively a problem for the Federal Government, but rather is one in which State and local authority can be effective and should be preserved. Federal action along several lines is suggested, however:

1. The present Federal statutory authority over oil pollution in the Great Lakes derives from the Rivers and Harbors Act of 1899 which prohibits the discharge of refuse and matter other than liquid sewage into the Great Lakes. Administered by the Corps of Engineers with assistance from other Federal agencies, it pertains principally to those materials obstructive or injurious to navigation.

The adequacy of this authority and the complex administrative responsibility for its enforcement should be reviewed. Consideration also should be given to broadening and applying the Federal Oil Pollution Act of 1924 to include the Great Lakes and to revising that act along the lines of regulations instituted by Canada in 1957 over its portion of these waters. The Canadian regulations specifically define what constitutes oil pollution, require each ship navigating Canadian waters on the Great Lakes to keep an oil discharge log, and require proper separation equipment. The regulations also prescribe for annual inspection of equipment and logs and for enforcement procedures.

2. The control of other shipboard wastes admittedly poses special and difficult problems. We commend the Federal agencies concerned for launching interagency discussions on the feasibility of establishing a cooperative project for the treatment and disposal of garbage and sewage by ships on the Great Lakes. We urge that this committee recommend the implementation and financing of such a project. State-level agencies and appropriate Great Lakes shipping interests should be invited to cooperate and participate in such a project.

3. In view of the limited experience with the risks of nuclear-powered shipping on fresh waters, it is recommended that the Federal agencies concerned exercise extreme caution in permitting such shipping to navigate the Great Lakes at this time.

4. While the pollution problems from small boating require primarily appropriate State and/or local action, consideration should be given to the use of the interstate commerce clause to prohibit movement across State boundaries of new boats lacking proper installations for the treatment of wastes.

Measures seeking to achieve a greater degree of regulation over the fluctuating levels of the Great Lakes

The Great Lakes Commission is concerned over the continuing delay in the completion of the Army Engineers' important study on the feasibility of a plan for regulation of levels of the Great Lakes that will best serve the interests of all water uses.

Levels of the Great Lakes fluctuate over irregular long-range cycles in a range of approximately 5 feet. Both the extreme high levels and the extreme low levels cause serious problems. High levels inundate shorelands and, by permitting storm erosion of the beaches, cause serious damage to shore properties. Difficulties are created in the docking and loading of boats and dock facilities are damaged. High levels also back up water in tributaries to the lakes and thus aggravate their floods and interfere with land drainage. Damages from high water levels in a single-year period (1951–52) caused $61 million in losses due to inundation and wave action according to official estimates of the Corps of Engineers.

On the other hand, low levels, which have characterized the Great Lakes in very recent years, reduce the cargo-carrying capacity of vessels on the lakes, expose unsightly flats, decrease the area of waterfowl nesting grounds and may cause excessive shoaling in some fishing waters. Low levels also may leave boathouses and docks high and dry and require extensive harbor improvements.

Originally authorized in 1952 and scheduled for completion in fiscal 1957, the regulation study by the Corps of Engineers still awaits the funds required for its completion. We understand most of the study has been done and that $125,000 would provide the funds to complete the report. We urge therefore that the Congress in the next session appropriate the funds needed to complete this vitally important study.

The Great Lakes Commission also has been concerned over the Bureau of the Budget's policy until this year, that inundation problems on the Great Lakes did not fall under the scope of the Federal Flood Control Act of 1936. We are pleased that the Bureau this summer announced a modification of its position and urge enactment of pending legislation in this Congress authorizing a number of beach protection projects on Lake Erie.

Programs to maximize the potential of the Great Lakes and St. Lawrence system for navigation and commerce

As already indicated, the Great Lakes and St. Lawrence system is one of the most important waterways in the world and annually carries a vast amount of commerce to the ultimate benefit of the entire Nation. Its maximum potential in this respect, however, is yet to be achieved and programs having that objective should be given a high priority in Federal water resource development programs.

The urgency of such programs for the Great Lakes stems in part from the deep-draft navigation made possible on the Great Lakes by the St. Lawrence Seaway but also is emphasized by the economic benefits that result when ships in the interlake traffic can carry larger loads of iron ore, coal, stone, and the other commodities basic to the national economy. This country, as one looks ahead to 1980 and 2000, requires a vastly enlarged and strengthened transportation system which will be capable of serving the needs of a greatly increased population and national product. This is the real justification for the St. Lawrence Seaway and for further navigation improvements in the Great Lakes.

Two specific areas of need, each of which bears directly on Federal policy and programs, are suggested.

1. Earliest possible completion of the deepening of the connecting channels to 27 feet is essential. Appropriations made by the Congress to date for this project, with an estimated cost of $146 million, total only about half that amount. If this project is to be entirely, or even substantially, completed by 1962, as originally scheduled, annual funds considerably more than those made available in the past must be provided. We urge therefore that, as a minimum, Congress appropriate $35 million annually for fiscal 1961 and 1962 for this project.

Equally important are the authorization of deep-draft improvements in Great Lakes harbors and appropriations for these projects. Improvements already found economically justified by the Army Engineers will require about $63 million, and indications are that other worthwhile projects ultimately will increase the total to $100 million or more. While these improvements obviously will require time, their importance to the full utilization of the seaway route demands action as rapidly as possible.

2. A sound policy dictates not only that projects found economically justified be completed as quickly as possible but also that proper maintenance be given once those projects are completed. Federal maintenance in Great Lakes harbors in recent years has followed an irregular pattern and has been hindered by the policy of the Bureau of the Budget which regards deferred maintenance much the same as new projects. As a result, the accumulation of deferred maintenance on the Great Lakes is estimated to be about $30 million to $40 million. We recommend that this backlog be given special attention and urge systematic appropriations to the Corps of Engineers to undertake and complete needed maintenance on an orderly and routine basis, and at considerable savings to the Federal Government.

Measures to rehabilitate and improve the fisheries of the Great Lakes

The valuable fisheries of the Great Lakes in the last several decades have suffered serious deterioration with resulting adverse effects, particularly on commercial fishing. Nevertheless the fisheries still constitute a valuable resource as is indicated by the recent average annual catch of about 117 million pounds valued at roughly $16.4 million.

In addition to providing this catch, the fisheries are an immensely valuable recreational resource. While no precise data is available on the extent and value of the catch taken by sports fishermen, indications based on a few limited areas suggest a take that is rapidly increasing and which may soon exceed the commercial catch in those areas.

The outstanding present problems in the Great Lakes fisheries are the decline of the valuable trout caused by the lamprey and, second, nonpredictable fluctuations in other species. The latter results in a general instability which works against efficient planning and preparation for commercial fishing operations and against efficient management of the fishery. The major requirements, in considering needed governmental action, are the eradication of the lamprey restoration of the lake trout and research on the short and long term environmental factors causing the fluctuations in fish stocks. Other needs are studies which would provide more adequate sampling of fish populations and of the harvest of sports fishermen and studies which would suggest means for utilizing presently underexploited species.

Fortunately much already has been accomplished in meeting these needs. Under the coordination of the international Great Lakes Fishery Commission, the Federal Governments in the United States and Canada, State and Provincial agencies and universities cooperatively have launched a major attack on some of these problems and needs. This is particularly true of the lamprey problem.

We are pleased to note that this program is showing fruitful results which justify the hope that the lamprey can effectively be controlled before too long. We commend the Great Lakes Fishery Commission and the Federal Government for the leadership and support which has made this possible.

The successful development of an effective larvicide against the lamprey, however, is the basis for the first of the needs suggested here as requiring Federal action. For development of the larvicide has shifted the emphasis from the development phase to the application stage, which thus far is on a modest basis and is limited to the fisheries in certain high-priority waters. Ultimately and to be successful it must be expanded to all of the Great Lakes. A major need therefore is adequate, which necessarily means increased, financing support that will permit expansion of the lamprey control program as rapidly as required for its administration in a sound and efficient manner.

The committee's attention also is directed to two recommendation submitted to the Federal Government earlier this year by the Great Lakes Fishery Commission. Both recommendations, which also were directed to the Canadian Government, point out two additional needs in the Great Lakes fisheries which directly and immediately relate to Federal policy in this field. The first urged both countries to provide the funds for a research program which would "simultaneously" permit, a "broad attack" on fisheries problems of the Great Lakes not now receiving adequate consideration. These problems already have been mentioned. The other, taking cognizance of the progress in developing and applying the lamprey larvicide, urged early provision by both Federal and State and Provincial Governments of the additional fish hatchery facilities needed for the next phase of the program—the restoration and rehabilitation of the lake trout.

The Great Lakes Commission endorses both recommendations and indicates its view that these, plus the expansion of the lamprey control program which soon will be necessary, constitute the major needs to which the Federal Government should addres itself in this field.

Programs which will increase our knowledge about the waters of the Great Lakes

In emphasizing this need we endorse the recommendations made in other recent studies or considerations of the Nation's water problems for acceleration of programs for the collection and interpretation of basic water data. It is axiomatic that such data are essential in formulating sound water policies at all levels of government and for intelligent planning and development of water resource projects. Unfortunately the defects and inadequacies in present data collection and evaluation programs cited by such studies as the Hoover Commission and the President's Advisory Committee on Water Resources Policy, by the Mid-Century Conference on Resources for the Future and by numerous others remain largely uncorrected.

The water resources of the Great Lakes are no exception in this respect. Considering the tremendous value of the lakes in all their multiple uses, much too little is known about such features as their currents, fluctuating levels, bottom topography and geology, biological productivity, capacity to absorb wastes, ice formation and movement, effect on climate, and so forth.

Organizations such as the Great Lakes Research Institute at the University of Michigan and the University of Minnesota's Lake Superior research station are attempting to supplement the limited data presently being gathered by Federal, State and local agencies concerned with the Great Lakes. The Federal Government in Canada and the Province of Ontario recently have embarked on a cooperative program for research on the Great Lakes. While these developments are encouraging, more needs to be done. Research of course requires money and the big problem in improving basic data on the Great Lakes is the availability of funds. The States clearly have an obligation and opportunity to meet this need for funds, but the national importance of this resource is sufficient justification for Federal action as well.

Three suggestions are submitted. First, the Federal Government's present program of basic water resource data collection should be expanded and should be programed and carried out on a more consistent and definite basis. Second, the present Federal program should reflect recognition of the unique nature of the Great Lakes which requires special adaptations and techniques in the

gathering and development of basic water resource data. Third, enactment of legislation, such as S. 2692, to substantially expand this country's program in oceanography should include, either by a specific amendment to the bill or by an appropriate expression of congressional intent, the Great Lakes in the waters to be studied by such program. This last recommendation, which Canada has implemented on the Great Lakes by the program referred to earlier, is based on the similarities in many respects between the oceans and the Great Lakes, the excellent opportunities provided by the Great Lakes for certain oceanographic studies, and the laboratory which the Great Lakes provide for the training of oceanographers.

Federal-State relations

The tasks of further developing this resource and of its wise management obviously demand cooperation among all levels and agencies of government, cooperation that includes the exchange of information and views consultation which extends from the planning to the operational phases of projects and programs, and coordination of plans.

Four principles to guide Federal-State relations in water resource programs, two of a general nature and two relating specifically to the Great Lakes, are suggested.

1. All water development projects initiated or proposed by the Federal Government should, as is now required in the Flood Control Act of 1944, be submitted to the affected States for their review prior to authorization of the project. This practice, already followed by Federal agencies in many instances, is sound and should be adhered to in all Federal water resource projects.

2. To every extent possible, the same principle of State participation should be applied to the planning and operation phases in water resource projects and programs.

3. The exhange of views and discussion of common Great Lakes water problems now achieved through the United States-Canada Interparliamentary Group is desirable and should be encouraged at all levels of government.

4. The U.S. sections of international bodies dealing with Great Lakes problems should, wherever possible, include direct representation from the States bordering the Great Lakes and should, as a matter of policy, at all times consult with the States and keep them adequately informed on matters under consideration relating to the water resources of the Great Lakes.

Mr. FAST. With your permission, I would simply like to summarize what we consider some of the major points and recommendations in our statement.

First, however, I do also want to add the commission appreciation to the committee for its study which it is now undertaking and particularly for the decision to hold the hearings here in Detroit today. I think we are particularly grateful and indebted to you, Senator, for that decision.

Senator HART. I think you speak an hour late. I am sure the chairman is the man you should be talking to.

Mr. FAST. Our statement today addresses itself to a single water resource—the Great Lakes—and summarizes what the Great Lakes Commission considers the major needs and problems in the further development and management of this resource. This statement throughout is directed primarily toward the role of the Federal Government. While such is the case we wish at the outset to make clear our recognition of the rights, duties, and opportunities of State governments and their subdivisions in further developing and supervising this resource.

As one considers the tremendous nature of the resources which we have in the Great Lakes and looks ahead toward 1980 and the year 2000 a basic conclusion is that in the Great Lakes this country possesses one of its greatest natural resources, a resource that has not yet seen the realization of its full potential of beneficial uses, but is

certain to do so increasingly as the requirements for water continue to grow. A second conclusion is that the objectives of State and Federal governmental policies and programs as they relate to this resource should be to provide improvements needed to realize the full potential which the Great Lakes offer and, second, to establish programs which will insure sound and efficient management of these waters.

Looking toward the Federal Government's rule here, assistance to the States, we suggest that the Federal action falls under five headings.

1. Assistance to the States in their responsibilities for maintaining the high quality of the waters of the Great Lakes.

Specifically what is needed, first, is that municipalities and industries must improve the treatment of waste they discharge into the Great Lakes. This we emphasize is primarily a local and State responsibility. We also emphasize, however, the importance of the various forms of Federal assistance administered by the Public Health Service directly and in the international boundary waters of the Great Lakes by the International Joint Commission, continued an expanded support of these programs is essential. Adequate pollution control requires not only the provision of dependable volumes of water for the dilution of the effluent but also the means for ridding the effluent, before it is discharged, of foreign substances—chemicals, detergents, salts, insecticides, and other contaminants—which seriously affect water quality. Unfortunately present methods for treating pollution cannot effectively cope with many of these substances, and as a result thousands of tons are discharged daily into waters which cannot purify and assimilate these wastes.

An urgent need, therefore, is an expanded program of research on improved means for treatment and disposal of industrial and other wastes which presently known methods and technology are unable to purify to the degree necessary for preservation of water quality. This, of course, is most urgent in the case of smaller inland bodies of water, in the Great Lakes region and elsewhere, lacking the waste-absorbing capacity of the Great Lakes waters. But the increasing amounts of such wastes finding their way into the Great Lakes almost must be a matter of concern, and we recommend, therefore, that Congress provide the appropriations necessary for an expanded and cooperative Federal-State program to develop improved means for treating wastes not treated, or only partially treated, by presently available methods. We are advised by sanitary engineers that, at the minimum, appropriations for such research should total several million dollars in the first year of an intensive 5- to 10-year effort. Such a program seems of equal importance to the present Federal program in desalinization research and should be accorded a comparable priority.

A second important need is for an expanded attack on the difficult problems in dealing with pollution resulting from increased shipping and recreational boating on the Great Lakes. Here again we emphasize that this is not exclusively a problem for the Federal Government, but rather is one in which State and local authority can be effective and should be preserved. Federal action along several lines is suggested, however:

1. The present Federal statutory authority over oil pollution in the Great Lakes derives from the Rivers and Harbors Act of 1899, which prohibits the discharge of refuse and matter other than liquid sewage into the Great Lakes. Administered by the Corps of Engineers with assistance from other Federal agencies, it pertains principally to those materials obstructive or injurious to navigation.

The adequacy of this authority and the complex administrative responsibility for its enforcement should be reviewed. Consideration also should be given to broadening and applying the Federal Oil Pollution Act of 1924 to include the Great Lakes and to revising that act along the lines of regulations instituted by Canada in 1957 over its portion of these waters. The Canadian regulations specifically define what constitutes oil pollution, require each ship navigating Canadian waters or on the Great Lakes to keep an oil discharge log, and require proper separation equipment. The regulations also prescribe for annual inspection of equipment and logs and for enforcement procedures.

2. The control of other shipboard wastes admittedly poses special and difficult problems. We commend the Federal agencies concerned for commencing interagency discussions on the feasibility of establishing a cooperative project for the treatment and disposal of garbage and sewage by ships on the Great Lakes. We urge that this committee recommend the implementation and financing of such a project. State-level agencies and appropriate Great Lakes shipping interests should be invited to cooperate and participate in such a project.

3. In view of the limited experience with the risks of nuclear-powered shipping on fresh waters, it is recommended that the Federal agencies concerned exercise extreme caution in permitting such shipping to navigate the Great Lakes at this time.

4. While the pollution problems from small boating require primarily appropriate State and/or local action, consideration might be given to the use of the interstate commerce clause to prohibit movement across State boundaries of new boats lacking proper installations for the treatment of wastes.

Measures seeking to achieve a greater degree of regulation over the fluctuating levels of the Great Lakes.

The Great Lakes Commission is concerned over the continuing delay in the completion of the Army engineers' important study on the feasibility of a plan for regulation of levels of the Great Lakes that will best serve the interests of all water users.

Levels of the Great Lakes fluctuate over irregular long-range cycles in a range of approximately 5 feet. Both the extreme high levels and the extreme low levels cause serious problems. High levels inundate shorelands and, by permitting shore erosion of the beaches, cause serious damage to shore properties. Difficulties are created in the docking and loading of boats and dock facilities are damaged. High levels also back up water in tributaries to the lakes and thus aggravate their floods and interfere with land drainage. Damages from high water levels in a single year period (1951–52) cause $61 million in losses due to inundation and wave action, according to official estimates of the Corps of Engineers.

On the other hand, low levels, which have characterized the Great Lakes in very recent years, reduce the cargo-carrying capacity of vessels on the lakes, expose unsightly flats, decrease the area of waterfowl nesting grounds, and may cause excessive shoaling in some fishing waters. Low levels also may leave boathouses and docks high and dry and require extensive harbor improvements.

Originally authorized in 1952 and scheduled for completion in fiscal 1957, the regulation study by the Corps of Engineers still awaits the funds required for its completion. We understand most of the study has been done and that $125,000 would provide the funds to complete the report. We urge, therefore, that the Congress in the next session appropriate the funds needed to complete this vitally important study.

The Great Lakes Commission also has been concerned over the Bureau of the Budget's policy until this year, that inundation problems on the Great Lakes did not fall under the scope of the Federal Flood Control Act of 1936. We are pleased that the Bureau this summer announced a modification of its position, and urge enactment of pending legislation in this Congress authorizing a number of beach protection projects on Lake Erie.

Programs to maximize the potential of the Great Lakes and St. Lawrence system for navigation and commerce.

As already indicated, the Great Lakes and St. Lawrence system is one of the most important waterways in the world and annually carries a vast amount of commerce to the ultimate benefit of the entire Nation. Its maximum potential in this respect, however, is yet to be achieved and programs having that objective should be given a high priority in Federal water resource development programs.

The urgency of such programs for the Great Lakes stems in part from the deep-draft navigation made possible on the Great Lakes by the St. Lawrence Seaway but also is emphasized by the economic benefits that result when ships in the interlake traffic can carry larger loads of iron ore, coal, stone and the other commodities basic to the national economy. This country, as one looks ahead to 1980 and 2000, requires a vastly enlarged and strengthened transportation system which will be capable of serving the needs of a greatly increased population and national product. This is the real justification for the St. Lawrence Seaway and for further navigation improvements in the Great Lakes.

Two specific areas of need, each of which bears directly on Federal policy and programs, are suggested.

1. Earliest possible completion of the deepening of the connecting chanels to 27 feet is essential. Appropriations made by the Congress to date for this project, with an estimated cost of $146 million, total only about half that amount. If this project is to be entirely, or even substantially, completed by 1962, as originally scheduled, annual funds considerably more than those made available in the past must be provided. We urge therefore that, as a minimum, Congress appropriate $35 million annually for fiscal 1961 and 1962 for this project.

Equally important are the authorization of deep-draft improvements in Great Lakes harbors and appropriations for these projects. Improvements already found economically justified by the Army Engineers will require about $63 million, and indications are that

other worthwhile projects ultimately will increase the total to $100 million or more. While these improvements obviously will require time, their importance to the full utilization of the seaway route demands action as rapidly as possible.

2. A sound policy dictates not only that projects found economically justified be completed as quickly as possible but also that proper maintenance be given once these projects are completed. Federal maintenance in Great Lakes harbors in recent years has followed an irregular pattern and has been hindered by the policy of the Bureau of the Budget which regards deferred maintenance much the same as new projects. As a result, the accumulation of deferred maintenance on the Great Lakes is estimated to be about $30 to $40 million. We recommend that this backlog be given special attention and urge systematic appropriations to the Corps of Engineers to undertake and complete needed maintenance on an orderly and routine basis, and at considerable savings to the Federal Government.

The outstanding present problems in the Great Lakes fisheries are the decline of the valuable trout caused by the lamprey and, second, nonpredictable fluctuations in other species. The latter results in a general instability which works against efficient planning and preparation for commercial fishing operations and against efficient management of the fishery. The major requirements, in considering needed governmental action, are the eradication of the lamprey, restoration of the lake trout and research on the short and long-term environmental factors causing the fluctuations in fish stocks.

We are pleased to note that this program is showing fruitful results which justify the hope that the lamprey can effectively be controlled before too long. We commend the Great Lakes Fishery Commission and the Federal Government for the leadership and support which has made this possible.

The successful development of an effective larvicide against the lamprey, however, is the basis for the first of the needs suggested here as requiring Federal action. For development of the larvicide has shifted the emphasis from the development phase to the application stage, which thus far is on a modest basis and is limited to the fisheries in certain high-priority waters. Ultimately and to be successful it must be expanded to all of the Great Lakes. A major need therefore is adequate, which necessarily means increased, financing support that will permit expansion of the lamprey control program as rapidly as required for its administration in a sound and efficient manner.

The committee's attention also is directed to two recommendations submitted to the Federal Government earlier this year by the Great Lakes Fishery Commission. Both recommendations, which also were directed to the Canadian Government, point out two additional needs in the Great Lakes fisheries which directly and immediately relate to Federal policy in this field. The first urged both countries to provide the funds for a research program which would simultaneously permit a broad attack on fisheries problems of the Great Lakes not now receiving adequate consideration. The other, taking cognizance of the progress in developing and applying the lamprey larvicide, urged early provision by both Federal and State and Provincial Governments of the additional fish hatchery facilities needed for the next phase of the program—the restoration and rehabilitation of the lake trout.

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In emphasizing this need we endorse the recommendations made in other recent studies or considerations of the Nation's water problems for acceleration of programs for the collection and interpretation of basic water data. It is axiomatic that such data is essential in formulating sound water policies at all levels of government and for intelligent planning and development of water resource projects. Unfortunately the defects and inadequacies in present data collection and evaluation programs cited by such studies as the Hoover Commission and the President's Advisory Committee on Water Resources Policy, by the Mid-Century Conference on Resources for the Future and by numerous others remain largely uncorrected.

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Three specific suggestions are submitted:

First, the Federal Government's present program of basic water resource data collection should be expanded and should be programed and carried out on a more consistent and definite basis.

Second, the present Federal program should reflect recognition of the unique nature of the Great Lakes which requires special adaptations and techniques in the gathering and development of basic water resource data.

Third, enactment of legislation, such as S. 2692, of which you, I believe, are a cosponsor, Senator, to substantially expand this country's program in oceanography should include, either by a specific amendment to the bill or by an appropriate expression of congressional intent, the Great Lakes in the waters to be studied by such program. This last recommendation, which Canada has implemented on the Great Lakes by the program referred to earlier, is based on the similarities in many respects between the oceans and the Great Lakes, the excellent opportunities provided by the Great Lakes for certain oceanographic studies, and the laboratory which the Great Lakes provide for the training of oceanographers.

Finally, Federal-State relations; four principles are suggested here:

1. All water development projects initiated or proposed by the Federal Government should as is now required in the Flood Control

Act of 1944, be submitted to the affected States for their review prior to authorization of the project. This practice, already followed by Federal agencies in many instances, is sound and should be adhered to in all Federal water resource projects.

2. To every extent possible, the same principle of State participation should be applied to the planning and operation phases in water resource projects and programs.

3. The exchange of views and discussion of common Great Lakes water problems now achieved through the United States-Canada Interparliamentary Group is desirable and should be encouraged at all levels of government.

4. The U.S. sections of international bodies dealing with Great Lakes problems should, wherever possible, include direct representation from the States bordering the Great Lakes and should, as a matter of policy, at all times consult with the States and keep them adequately informed on matters under consideration relating to the water resources of the Great Lakes.

Senator HART. Thank you, Mr. Fast.

I should, for the record, add your qualifications on Federal-State relations.

Mr. Fast and I first met when he was in charge of the Central States region for the Council of State Governments. He is speaking in an area of expertise here.

Mr. FAST. Thank you very much.

Senator HART. Thank you for coming.

In order that we make the best use of this opportunity, and because we have assembled here many who have direct concern in many aspects of the Great Lakes Basin region, I think I ought to introduce and ask the several representatives of Federal agencies to stand. They are here not to testify but to backstop us when any technical question might develop. If you know they are here and know their identity, it is possible that you might profitably exchange a visit with them during the course of the noon or the afternoon.

These agencies will present their formal testimony at hearings before this committee in Washington.

I would like the Department of Agriculture representatives to stand. I understand that Mr. Nelson, the regional forester who is headquartered in Milwaukee, is here. Mr. Rickey, the watershed management section, also in the Milwaukee regional office, and the State conservationist, in charge of State conservation work in Michigan, Mr. Collins, is, or was here and will be back.

I think most of us know Colonel Wilson of the Corps of Engineers in the Detroit district.

I should add that the life of the representative of the Corps of Engineers is much more peaceful at this hearing than was the case in some of the irrigation States.

I understand that the Public Health Service of the Department of Health, Education, and Welfare is represented from their regional office in Chicago by the regional program director, Mr. Poston, and Mr. Ayres, the executive secretary of Water Pollution Control Advisory Board out of Washington.

And the Bureau of Fish and Wildlife Service is represented by Walter Schaeffer, chief of the division of technical services out of their Minneapolis office.

It is no surprise to those of us in Michigan that a man who has expressed concern far ahead of the pressures of the body politic in the city of Detroit over a long period of years, has been sitting here all morning. I think he could tell us more than all of us will hear today. I would like for the record to show he is present and I want you to meet this individual, Councilman Dell Smith, who is sitting, as he always does, way in the back.

The next witnesses are from Michigan State University. The first of them is the chairman of the department of resource development, Raleigh Barlowe. He, among other things, has distinguished himself by advance study in irrigation in the East generally. I realize he has a paper which will be presented in full in the record, but I would welcome his presentation orally now.

STATEMENT OF RALEIGH BARLOWE, HEAD, DEPARTMENT OF RESOURCE DEVELOPMENT, MICHIGAN STATE UNIVERSITY

Mr. BARLOWE. Thank you, Senator Hart, for those kind remarks.

My comments here today—I would like to limit myself to the question of research needs in the matter of water resources. This is really limiting myself, but I think it is the most pertinent material that I could present to the committee.

By way of preface on this I think I should indicate that for a good many years I have worked in research in teaching for the primary emphasis on the problems of the legal and the economic aspects of water use. This will probably influence the comments that are made here.

In working with the problem of water in Michigan over the last 12 years, I have been particularly impressed with the increasing amount of attention and popular interest that the water problems are receiving. This is not unusual to Michigan. It is a common problem all over the United States. People are getting much more interested in water.

I think an economist looking at this would like to explain this rise of interest in terms of supply and demand relationship. We can think in terms of water supplies being relatively limited in a physical sense. At the same time, the problems of rapidly increasing population pressure is a matter of increasing per capita demand for water. Some of the technological developments we had contributed to the problem of pollution. They have all certainly contributed to a big water problem. With this increase in a demand for water cities and individuals once thought in terms of water as pretty much a "free good" and very much had to think in terms of spending money in order to get additional water supplies. This involved a definite cost to them and made us more conscious of the economic aspects of the economic problem.

As a matter of fact, part of this cost situation—I think we are beginning to think of water not as something that is a free good anymore but of water as something that gets very much into the political and the marketplace pricing type of allocation.

Now, in addressing myself to the problem of needs for water research, I intend to use a threefold type of classification. I like to think in terms of some of our problems being primary physical and biological in nature. Then we have a group of water problems that

are primarily of a legal and governmental nature. We have a third type of problem getting very much into the economic and social sphere.

I am not going to comment very much on the need for additional research on physical and biological problems. Suffice it to say that I would like to back up everything Dean Fontanna has said on this. We do not know anywhere near enough about the physical and biological relationship involved in water.

When we get into the legal and governmental field, we have had considerable interests in studies in recent years here in Michigan and other States on this matter of water rights and water law. I think this has been good. We need more studies of this nature. I think these studies can help our legislatures in facing up to this problem in the future.

In addition to this type of study, we need some very basic emphasis on the down-to-earth relationship; some of the administrative law—very often I think it involves extralegal decisions that decide how water is actually used down on the level below what the statute books say.

We also need quite a bit of research in the area of what type of governmental organizations, what type of district arrangements, things of this order are needed to facilitate the operation of water law in the future.

In the third area, the area of economic and social emphasis, I think I could indicate rather easily here that we probably had very few water problems that cannot be solved at a cost, and if we are willing and put in enough determination in this we could probably minimize pollution. We may even rule it out entirely at a cost. We could take the salt out of sea water and transport it from one end of the Nation to the other at a cost.

The real question here is the matter of cost. The matter of economics, and social justification of some of these costs is also present. I think it is quite obvious in many cases we are not willing to pay the cost that it is going to take to take care of the water problem.

What I would like to stress is the need for much more research in this area. I have given some attention to this in the past. I think if you review the literature on this you will agree with me that while economists probably made some contributions, we have done quite a bit in terms of benefit-cost ratios, but that a great deal more work needs to be done here. I think we have barely scratched the surface.

Now, as we look at the overall matter of research, research needs, we could stress the fact that we have a water problem coming up in Michigan in spite of the great amount of water resources we have. A good many other States have even more pressing problems coming up. And as we look ahead to the problems that are coming up we are going to need a lot more factual data to make intelligent decisions. This is where we really need a sound, firm, factual basis and some good research in order to make up our decisions in the future.

I think, looking at this overall, you can think in terms of the major natural resources we have and we are definitely behind in water research. I do not think there is any of the major natural resources that we are more behind than the matter of basic water research.

Looking at the way out on this I have a feeling that Congress should do something in this area helping to encourage research here.

It seems to me that the problems faced by agriculture were not more serious at the time we started agriculture's experiment stations system than they are with water at the present time.

The problems faced by forestry when we set up the forest pilot laboratories, some of the problems involved in some other regional laboratories are no more serious than those faced by water at the present time.

There are a number of other approaches used on how the funds would be doled out, how the funds were used to advance research. Perhaps some of it could go to the States on a States-matching basis. It might be outright grants.

I liked the idea of a regional studies center to deal with water research. I should say perhaps several regional centers. I think our problems are different in different parts of the country. I hope very much that Congress would see fit to establish a regional study center centered with water problems here in this part of the country. Our interest in Michigan is such that I would like to see it established in Michigan. As a Michigan State booster I would like to see it on the Michigan State University campus.

There is a final statement here. Let me just say I think that any serious and reasonable valuation of our present water resources picture, any consideration being given to the emerging view of the complicated water problems that are bound to come up in the future certainly signals a pressing need for additional water research. It is obvious to me and I think to many other people that the time has come for a concerted drive for additional research, for studies that will help us deal with our problems more wisely, for research answers that will help us solve or alleviate many otherwise serious problems.

I think it is imperative that the Federal Government take more interest in this problem and also that it back up this interest with additional financial support and research.

Senator HART. Thank you very much.

You emphasized the basic problem, that of the supply-demand relationship. It changes and there is the lack of real understanding of it.

I should note that the committee is and has contracted with the Resources for the Future of the Ford Foundation to make such a study. We anticipate it will be one of the most difficult of all the assignments. Frankly, we can only wait until we see before we make any guess about it.

I am glad you emphasized the necessity for this.

I am glad you emphasized, too, the fact that solutions are not to be found in the bargain basement. I know it is a very attractive political speech, but I think this point has to be made over and over again. It relates to more than just water. I for one have not been convinced yet that the cost of survival will be cheaper next year than last year. I hope that the people of the Nation which insists it will lead the free peoples of the world will seriously examine any suggestion that it is possible to do it cheaper. The more we hear about the problems of water the more impressed I am that this is one of the items that has ot be put on the list as expensive but necessary.

Thank you very much, Doctor.

Mr. BARLOWE. Thank you for this opportunity.

(The prepared statement referred to follows:)

STATEMENT OF RALEIGH BARLOWE, HEAD, DEPARTMENT OF RESOURCE DEVELOPMENT, MICHIGAN STATE UNIVERSITY

WATER RESEARCH NEEDS

One of the most interesting happenings in the natural resource area during the post-World War II period has been the growth of popular interest in the problem of water. People all over the United States have displayed increasing awareness of the fact that our water problems have no natural built-in solution. Many areas have experienced the devastation and other problems associated with the occasional advent of too much water. More generally, however, the water problem has involved shortages of this resource, or what might more accurately be described as smaller available supplies suited to the particular uses users have in mind and priced within the cost range they are willing to pay.

It is difficult to characterize our water problems in simple terms. Chemically, water may be viewed as a simple compound; but it is the basis of one of our most complicated sets of resource problems. As a basic resource, water is essential for plant and animal life. It is one of the most plentiful resources on earth, but it can be and frequently is a scarce and limiting factor in the production and life-sustaining processes. Traditionally, it has been treated as a free good; but under many circumstances, it commands a substantial price. Its movement in the endless chain of the hydrologic cycle makes it one of our most migratory resources. Yet it can and frequently is stored for later use, and in some cases—as in the pumping of certain ground water reservoirs—it must be treated in our time as an exhaustible and nonreplenishable resource.

Changing supply and demand relationships are largely responsible for the recent upsurge of interest in water. On the supply side, the annual accretions to the overall supply of water that we secure from rainfall and other forms of precipitation are more or less fixed by the normal functioning of the hydrologic cycle. Demandwise, however, our increasing population numbers, rising per capita needs both for fresh water supplies and for the outdoor use of water resources, and the impact of new industrial establishments, garbage disposal units, and other similar developments on the water pollution problem have caused a skyrocketing of our overall water resource needs.

The impact of this rapid increase in total and per capita demand for water on our physical supply base is forcing many changes in our traditional outlook regarding water. High quality water is no longer as freely available to all users, or even to average users, in the quantities they want at the locations and times they want it as has been the case in decades past. Cities and individual operators have found that they must often spend sizable sums to augment their water supplies. Large investments and cost outlays also are needed to control and minimize the pollution problems. These types of expenditures have stripped water of its time-honored classification as a free good and have brought its allocation partly, but not entirely, into the sphere of our market economy. Numerous problems involving costs, administrative pricing and water-rationing policy, and individual operator decisions have come to the fore with this transition, while still other problems have reared their ugly heads at those locations where water has become physically as well as economically scarce.

Various classification schemes can be used to categorize the numerous problems and issues involving water resources. Some individuals find it desirable to think in terms of isolated water problems—problems such as those faced by the limnologist, the hydrologist, or the watershed management specialist. In looking at our overall needs for additional water research though, a more general classification system has advantages. For our purposes, it is convenient to divide water problems, and more particularly our research needs involving water, into three broad classes of issues: (1) The physical and biological, (2) legal and governmental, and (3) economic and social. Considerable research and far more knowledge is needed concerning each of these facets of the water problem if we are to minimize our task in coming up with the right decisions regarding water in the future.

Many valuable studies concerning the physical and biological aspects of water have either already been made or are currently underway. Almost every student of water, however, will agree that far more needs to be known about the physical extent of our water supplies and the physical and biological uses made of water. In facing up to our future water problems, it is important that we know

much more than we now do about the problems of evaporation and transpiration, the atmospheric conditions that induce rainfall, the underground movement of water and recharging of our ground water reservoirs, the use of water by plants, watershed problems, the minimum and optimum quantities of water required for various industrial processes, and a host of other physical and biological relationships involving water resources. Considerable data also is needed concerning the engineering aspects of possible water resource developments and the potential effects of these developments on worker productivity and the probable growth of particular areas.

Several studies have been undertaken in Washington and in varying States on the questions of water rights and water law. The changing water situation will undoubtedly call for numerous modifications of our existing water laws. Changes of this order must be anticipated both in the Western States that accept the appropriation doctrine and in the Eastern States that endorse varying versions of the riparian doctrine. Research findings can play a helpful role in all the States in helping legislatures adopt their water laws to the changing needs of our dynamic economy. Research attention should also be given to a variety of other problems involving the legal and governmental aspects of water. More needs to be known about the administrative actions and the on-the-spot, often extra-legal, decisions of operators and local administrators that frequently determine how water actually is used. Research also is needed to indicate the governmental arrangements and patterns of organization that can best be used to administer drainage, irrigation, flood control, watershed development, metropolitan water supply, and other similar water resource programs.

With our changing outlook regarding the nature of water, it is becoming increasingly necessary for us to emphasize the economic and social nature of our water problems. The economic and social benefits associated with our use of water are normally provided at some definite cost to the individual, to the producer, or to society. As a matter of fact, almost every water problem we have can be solved at a price. If need be, we could completely stop the pollution of our streams. We would desalt sea water and transport it from one end of the country to the other. The real problem is one of cost. How far can we go with our solutions and still justify them in ecnomic and social terms?

Along this same line, one may ask: How much of the cost associated with the provision of new or better water supplies should be passed on directly to the consumer? How much of this cost should we try to underwrite with tax revenues? Should we allow prices to allocate water resources or should we use a combination of rationing and pricing techniques in our public policy decisions regarding the distribution of water supplies? These and other questions involving the provision of water supplies, the allocation of water between uses and users, the feasibility of pollution abatement programs, and other similar matters call for more research on the economic and social aspects of water use. As a part of this effort, detailed analyses are needed concerning the actual benefits and costs associated with water developments and water use. Studies also are needed to develop and explore many economic and social facets of the water problem that have as yet received little or no research attention.

Several agencies in our Federal and State Governments, in our universities, in private companies, and with local governments and planning groups are currently conducting research on water problems. Some of these agencies enjoy more financial support and are better staffed or have less competing claims on their time than others. Needed research is being carried on with some success; but most of our research agencies lack both the financial support and the staff to do more than a fraction of the research they should be doing in the water area. Numerous instances could be cited in Michigan, and probably in other States as well, of basic physical research—the results of which will be sorely needed in a few years—that is being postponed because of budgetary problems. With all due respect to our past and present research in the water area, it should be emphasized that we are further behind in water research than in our research with any other major natural resources.

A realistic facing up to our future water problems indicates that we have experienced only the beginnings of what can become a critical clash of interests concerning the use of water. More people and rising levels of living signal greater demands on our existing water supplies, more competition between users, and a definite need for positive programs to promote the optimum and orderly use of our water resources. These programs can be developed on a hit-or-miss basis. Real advantages can be enjoyed, however, if future programs and policies

can be based on a firm factual basis, if they can be premised on sound research findings.

A greatly expanded research program on water problems is definitely needed in the future if we are to minimize the problems that lie ahead. The research studies currently underway will be of great help. But far more research is needed. Additional Federal and State financial help is definitely needed to get new studies started and to facilitate the continuation and expansion of many studies now underway or now in the programing stage.

The research problems faced in the water field today are no less imposing than those that faced agriculture when Congress provided Federal financial aid under the Hatch Act in 1887 for setting up the State agricultural experiment stations. They are fully as important as those that caused Congress to appropriate funds for establishing the forest products laboratory at Madison, Wis. in 1912 and which prompted later appropriations for the establishment of a regional corn products laboratory in Illinois, an animal diseases laboratory in Iowa, and various other special study centers throughout the Nation.

As the above precedents suggest, Congress would be acting well within its powers if it decided to make funds available either on an outright grant or on a State grant-matching basis to promote needed water research. Regional study centers representing both the humid and arid sections of the Nation could also be set up to advantage. Our longstanding interest in water research would make Michigan—and if I may be more specific, the Michigan State University campus—a logical site for a regional water study center.

As a concluding note, it may be observed that any serious evaluation of our present water situation, and of our emerging view of the more complicated water problems that are bound to come in the future, will show a pressing need for additional water research. It is obvious that the time has come for a concerted drive for more water research, for studies that will help us to deal with our problems more wisely, and for research answers that will help us to solve or alleviate many otherwise serious problems. The Federal Government has a definite stake in this problem. It should show greater interest in this problem area, and it should back this interest up with additional financial support for needed research.

Senator HART. The committee is in receipt of a most interesting analysis prepared especially for this hearing from Clifford Humphrys, of the Department of Resources Development at Michigan State, who will be glad to know that it was one of the documents that the chairman, Senator Kerr, took with him for review prior to completion of the record.

I know it is not possible to read the document, but it will be made a part of the record, and we would welcome, Professor, your making a brief suggestion about just how this came about. It should be very interesting.

STATEMENT OF C. R. HUMPHRYS, DEPARTMENT OF RESOURCES DEVELOPMENT, MICHIGAN STATE UNIVERSITY

Mr. HUMPHRYS. Senator Hart, Representative O'Hara, I am very pleased to be here this morning.

I have a 2-page extract in this rather voluminous study that I will refer to for my presentation here.

I respectfully request that the entire report be submitted for the record.

Senator HART. The entire report will be placed in the committee's files for reference purposes.

Mr. HUMPHRYS. I think part of our effort here in Michigan must be devoted toward thinking of water as a critical resource. I also believe that the public lags behind the technical knowledge that we now have. For some reason or other conservationists have not been able to get

their concepts, their philosophy, their theory, across to the public. We might have to turn to new avenues of dissemination of information.

I am also quite interested in analyzing an approach to water. First of all, I think we are faced with meeting the expedient demands brought on by problems, but we cannot let these divert all of our attention. We should continuously be building up our supply of facts not only to answer these current problems, but to think ahead.

I would also like to think of water not being confined just to a stream or to a lake. When you speak of water, you are speaking of upland areas, the land use, the vegetation. It is very important.

Now to the abstract.

I state initially that water is a rather peculiar mineral. In fact, it is a miserable mineral to manage. It changes form rapidly, in nature, from a solid to a liquid, to a vapor, in a period of a day. It is also migratory. But I do not think this should frighten us because we have dealt with migratory minerals such as oil and gas and brine and found that they could be managed and they could be conserved. It is also a universal solvent and that gives rise to the problem of pollution.

These are natural characteristics that put water in a class by itself.

Culturally, there are also some characteristics that are extremely important. We know that there is a growing demand for water.

Secondly, it has no value. The only value that we have attached to water is the bill we pay when it is delivered. In other words, we pay for the well, the pumps, the pipeline, the treatment system, but we do not pay anything for water. Eventually, if it is soon of value, such as oil, I think we will be apt to attach more importance to its management.

We also suffer frequently from too much and too little.

Also, there have been considerable sums of public money devoted to its development and utilization, somewhat in a class by itself as a resource.

Geographically, the legal systems of water rights and comparing the east and west are almost diametrically opposite.

Knowledge of water is not packaged as well and it is clearly labeled as knowledge before us, for soils, and for other resources.

Water pollution has caused a decrease in local supply.

Eastern States are much more apt to place different values on water than Western States in thinking of the national concept of water. I think this is important and going to have to be solved.

Depending upon time, location, and use, water may be classified as a nonrenewable resource, as a renewable resource, and as a flow resource. This again places it as a difficult mineral to manage.

In terms of yields, the better we can manage water the more work we can get out of it.

In terms of public responsibility at all levels from the Federal, State, and on down, many of the management practices and programs have been splintered in the way that is somewhat unrealistic. I think all of the committee reports that you referred to in your original release indicated that we may need a centralization for water.

Ancient, traditional uses, such as navigation, have a way of limiting our current use and are certainly going to slow up future use.

The allocation of water is being determined upon legal criteria in some areas, upon economic criteria in other areas, and upon intangible criteria in still other areas.

These are the cultural characteristics that make water somewhat of a challenge when you begin to think of management. In terms of recommendations, I have set down 10 recommendations, and I will go through them very briefly.

The first three deal with pollution.

I recognize in Michigan this is one of those expedient problems that we have to address ourselves.

Thinking of this, I think that those State and Federal moneys should be quickly allocated to initiate a research program, oriented to the goal of complete industrial waste treatment. I am thinking in terms of the public accepting some of the responsibility. In many instances, the public has insisted that when industry moves into a local area it opens all the doors. Then, 20 years later they say, "We want you to change your method of effluent treatments." The local area has gained from that industry moving in. If they clean up their effluent problem they will also gain. Therefore, I can see the public should accept some of this responsibility.

We cannot carry it back upon the industrialists.

Recommendation 2: The 1956 Federal Water Pollution Control Act should be strengthened and continued. This is the act that emphasizes aid to local municipalities, in sanitary waste treatment, and it has been extremely successful. It has helped communities that could not initiate a program on their own by priming the pumps.

Recommendation 3: A research program should also be organized and be adequately financed to investigate the feasibility and effects of underground waste disposal.

Most of us who work in the field of water fear to even discuss this as a possibility. If we do not find out something about it it will not be done.

The fourth recommendation deals with water rights and oriented to Michigan. It is my feeling that the initial legislation aimed at solving water right problems should provide for study and research. This study should survey the water resources of Michigan both quantitatively and qualitatively. It should also investigate all of the ramifications of use and cultural modifications.

The remaining recommendations deal with research. The biggest problem I think we have in research in the water field is the evaporation-transpiration rate. This is where you have to go out on the ground and climb upland. You cannot ride around in a boat on a lake or stream and work on this.

Vegetation will use from 60 to 70 percent of the water. If we wanted to devote our money in the field that would most increase our total supply of water here is the place to do it. Sixty to seventy percent of the water is being used by vegetation and, as Dean Fontanna said, you can change your species, you can change your management techniques, and you can increase the yield of water locally. This is not a 100-year program. You can do this within a period of a few years.

Recommendation 6: A reconnaissance survey of Michigan's ground water, the sources should be initiated at the earliest possible date.

This is one of the most valuable parts of the water resources in Michigan. It has not been tapped as yet in great quantity. However, it is the resource that everybody points to when they think of expansion. We better learn something about it if we intend to develop it, to use it and manage it.

Now, a survey does not mean that you have to learn what water is under every square foot of Michigan. A reconnaissance survey would be of great value. This is not a simple thing to come by. It costs money, it takes trained people and it takes time.

Recommendation 7: The study of surface water movement must be intensified by the installation of numerous gaging stations on major streams, minor streams, and even tributaries.

I do not think you can put up one experimental station at the mouth of the stream and get all the data you really need. You have to collect data on the tributaries also if you are going to do management.

Recommendation 8: A statewide survey of water use should be initiated in order to determine the nature of the use, the quantity, and the quality required, the location of the demand, the sources best suited, seasonal demand variations.

In Lansing, the peak of the Michigan State University water demand does not occur at the same time that the peak of Lansing occurs. If they both occurred simultaneously we would have more problems than we now have.

A lot can be learned from studying when people want to use water. Also the nature of the effluent produced, just what do people do with water when they use it? We have some pretty good ideas of what happens to some water when it is used and the way it looks when it comes out. But these are examples of mostly stream cases. There is a lot of effluent that does not come under this general blanket that we condemn so violently.

The point on item 8 that I am most interested in is what is this intake-output ratio. If Detroit uses a certain amount of water a year how much of that gets back into the Detroit River?

How much of the water that Lansing uses gets back into the river? I suspect that the evaporation rate and the transpiration rate from lawns and trees, take more than a nibble from this total demand for metropolitan areas.

Recommendation 9: This I think is where the conservationist has fell flat. A study of the evaluation of intangible values of water use should be implemented in order to establish criteria for the evaluation of recreational water values on a level commensurate with tangible water values now associated with industry and agriculture.

An engineer from the Ford Motor Co. can tell you in dollars and cents, pounds and tons, and length and width what he needs, what he is going to do with and what he ends up with. But if you take any inland lake in Michigan and attempt to do the same thing you would be embarrassed.

How do you measure the value that people get from using lake frontage or stream frontage? Maybe they just drive by close to Lake Michigan and look out across it. How do you measure it? We cannot continuously avoid this one.

Now, the big problem here is that if we do not measure it, find some way of measuring it, the argument is going to be emotional in

nature, and emotional arguments are extremely important in the United States.

As an illustration, the threat of flooding some of our parkland in the Western States; we had an illustration in Michigan, that is, the Porcupine Mountains in which mining was promoted. The emotional arguments eventually outweighed the tangible facts.

Recommendation 10: A statewide survey should be initiated to determine the present state of multiple use of water resources.

We know very well that a lot of water is being used in Michigan. How much is being used on a multiple use basis? What are the compatible, multiple uses?

You cannot put cats and dogs in the same box and expect them to get along. We should try to determine which are the compatible, multiple uses, how they got together, what are the mutual benefits and how can we encourage more of this. This is getting more use out of water.

That is the extent of my comment.

Senator HART. Professor, first, thank you for the specific set of recommendations.

I should add that one of your recommendations, the one numbered nine, evaluation of the intangible values of water, the chairman of this special committee, Senator Kerr, who is also a member of the Public Works Committee, has stated publicly as of yesterday he is considering very seriously seeking to add to the next Rivers and Harbors Act. The idea is to give us a formula to assess the benefit that accrues from some of the intangibles which heretofore, as you say, are either ignored or overstated.

Thank you very much for the presentation. I said that we would take a brief breather, and I suggest that we recess for 15 minutes and that we return at quarter to 1. I think that those of you who are anticipating to be called have this witness list, and we do not know whether Dr. McGinnies of the Muskingum Watershed Conservancy District in Ohio has a statement to make orally or merely to file. We will then come to the Farm Bureau, the League of Women Voters, and thereafter the balance.

(Thereupon, at 12:30 p.m. the committee recessed to reconvene at 12:45 p.m. the same day.)

AFTERNOON SESSION

Senator HART. The committee will be in order.

I indicated when we took our recess that speaking for the Muskingum Watershed Conservancy District in Ohio would be Dr. McGinnies. I understand the doctor is sick and could not be present today.

Am I correct in that information?

Next we will hear from Mr. Walter W. Wightman, representing the Michigan Farm Bureau.

Before he left, Senator Kerr said that at all the hearings the committee heard from the League of Women Voters. Also at all the hearings where I have been in attendance we have heard from the Farm Bureau.

STATEMENT OF WALTER W. WIGHTMAN, PRESIDENT, MICHIGAN FARM BUREAU

Mr. WIGHTMAN. Thank you, Senator Hart.

We wish to express appreciation for being invited to testify at this hearing.

I would like to say that probably I am pinch hitting here for Dan Reed, who you corresponded with, first, and mainly because I happen to sit on the Water Resources Committee of the American Farm Bureau Federation Board and also on the National Soil and Water Conservation Advisory Committee appointed by the Secretary of Agriculture.

My name is Walter W. Wightman. I am a farmer at Fennville, Mich. I am appearing before the committee today on behalf of the 72,361 farm families who are voluntary dues-paying members of the Michigan Farm Bureau, of which I am the State president. I am also a director of the American Farm Bureau Federation and member of its committee on soil and water conservation. I am also a member of the USDA Soil and Water Conservation Advisory Committee, appointed by Secretary Benson.

Our members and other Michigan farmers have a growing interest in water resources and water rights. Repeatedly, for more than a decade, the delegates at our annual conventions of the Michigan Farm Bureau have adopted resolutions on these matters. At our last State convention the delegates approved the following statements which may be pertinent to the problems being explored by this committee.

I believe that probably farmers realize as much as anyone the importance and value of water as being one of our most important natural resources though it does not really cost us anything, but we could not do very much without it.

WATER RIGHTS

The growing interest in problems of water management and the right to the use of water indicates that there is a need for a comprehensive study by all interested parties, which should lead to recommendations for legislative action.

Michigan is favored in having available the world's best supply of fresh water. However, many areas of the State inland from the Great Lakes, experience local shortages. The water of many streams is totally used at present during low flows either for municipal or industrial purposes or for irrigation.

High investments are needed to develop irrigation projects. Other water users also want to know what water supplies they may continue to expect. We will support an adequate study of our water resources and needs which will develop equitable water rights legislation.

We urge that the joint legislative committee studying this problem be continued and that sufficient funds be provided to enable the committee to do an effective job.

FLOODING FARMLANDS

We are alarmed by proposals to flood thousands of acres of our good agricultural lands to provide water storage during flood periods for release during low water to maintain streamflow.

We are not unsympathetic to the problems of industries and municipalities whose expansion may be hindered by lack of waterflow. We are, however, concerned about uprooting of large numbers of farm families, the removal of valuation from tax rolls, and the tremendous amounts of our better farmlands which are being permanently taken out of food and fiber production by urban and suburban developments, industrial operations, superhighways, and other land-consuming developments.

We believe that thorough study of other alternatives should be carried out before consideration should be given to the flooding of areas which would become mosquito-breeding mudflats during the summer drawdown of water. The right of eminent domain, permitting condemnation of land, is a power that should be granted only in clear cases of public necessity.

SMALL WATERSHED PROGRAM

We endorse the small watershed program as an effective technique for dealing with surface water problems. We believe much more emphasis should be placed on this method of water control.

I believe I heard this statement that the Federal appropriations for watershed program is about $25 for lower and major watershed activity compared to about $1 on these upper watersheds that we feel probably are quite important and probably will solve a lot of problems that would not be so serious in the lower watershed if they are properly taken care of.

Senator HART. Mr. Wightman, I should interrupt you there to say that as recently as yesterday Senator Kerr and Senator Case of South Dakota, both made a comment which would indicate that they feel strongly as you do that the small watershed program offers an opportunity dollar for dollar which is very great and should be emphasized.

Mr. WIGHTMAN. Responsibility for the use and improvement of land and water resources rests on all citizens, urban as well as rural. Cities are dependent on rural lands not only for food, but for most of their water supplies.

The anual increase in our population places a definite responsibility on agriculture and the Nation to safeguard our needed future food production facilities. Farm owners and farm renters as well as our urban population must be aware of the need for intelligent use and conservation of our lands.

The 75 soil conservation districts now organized in Michigan are efficiently operated by elected farmers serving without salary and are effective units of soil-saving activity.

We commend the legislature for its action in providing part-time assistance to these volunteer officers. We ask that this aid be extended to all districts on a matching basis.

Our delegates have repeatedly urged that well drillers be required to maintain a log of soil and rock formations and file the information with an appropriate agency. It was their feeling that this would provide much needed information on our underground water reserves.

We have consistently maintained the position that management of our water resources should be recognized as a problem of State rather than Federal jurisdiction. This does not mean there are not questions

where there should be some Federal jurisdiction, but we think a lot of the problems can be solved better in the individual States.

As long ago as 1948 we were concerned about these matters. That year our delegates adopted the following statement in this connection.

WATER RESOURCES

The water table and availability of an adequate supply of water for domestic use, livestock, and industrial purposes are becoming serious problems in many sections of the State. This whole situation is now being studied by a committee from the Michigan Legislature and by various State agencies. We favor all reasonable and necessary regulations relative to the use and reuse of water for industrial purposes and irrigation. We particularly stress the importance from the standpoint of public health, conservation, and the tourist industry of the prevention of pollution of our rivers and streams by municipalities and industries.

State legislation should be enacted which would clarify the right to the use of water for various purposes by individuals and corporations.

We have gone over some of the preliminary statements which were prepared by various State agencies for submission at this hearing and commend and endorse these reports which we have had an opportunity to study. We feel that they present much factual and timely information which should prove of value to this committee.

Farmers are directly interested in water resources in at least two ways. Each farmer usually has his own well to furnish water for domestic and livestock purposes. In some sections of the State the water table has fallen so drastically that many farmers have had to drill new and much deeper wells than those which had served their needs previously. Also, an increasing number of farmers are now using irrigation for the production of various crops. Substantial investments are being made annually in larger and deeper wells, piping, hose, pumps, and so forth. While only about seven-tenths of 1 percent of the actively farmed cropland of the State is now being irrigated, this practice has increased fivefold in the 10-year period 1947–56. According to the latest information that we have, there are now 70,000 acres under irrigation in Michigan.

Many of our members are included among the 33,000 Michigan farmers who are cooperators in the 76 soil conservation districts operating in Michigan. Also, many of our members are taking advantage of the USDA conservation cost-sharing program. These various land use practices are an effective part of water development and control. It is estimated that 98 percent of the total precipitation falls on the land surface. It either runs off overland or enters the ground, depending upon the type of rainfall, the condition of the soil and its vegetative cover. Such land treatment practices as contour farming, strip cropping, vegetative cover, et cetera, control erosion, reduce water runoff, and prevent siltation of ditches, streams, and reservoirs. A fertile topsoil has a great water absorbing capacity.

During the current session of the Michigan Legislature we supported a bill which would have permitted impounding of excess water for later use. This would have had many obvious advantages, one of which would have been a reduction of flood damage.

Our members also have a broader interest in all phases being considered by your committee. We recognize the tremendous importance of an adequate and safe water supply to the well-being of all segments of our total economy, including cities, industry, and our tourist and resort attractions. One of the factors entering into this picture is the maintenance of our Great Lakes level on a reasonably dependable and stable basis. Any drastic raising or lowering of that level would result in very serious losses and costly damages to all those living or having activities along the 3,251 miles of Great Lakes shoreline in Michigan.

Undoubtedly your committee has seen or has access to a 35-page statement with numerous attached exhibits submitted by the American Farm Bureau Federation before the House Committee on Interior and Insular Affairs with reference to H.R. 5555 under date of July 22, 1959. That is a broad and comprehensive statement which expresses the position of our organization on the matters being investigated by your committee.

In concluding our testimony we desire to emphasize the importance of the preeminence of the rights of individual States to determine the use of the water within their boundaries which does not have interstate or international implications. We are deeply concerned about activities of individual States or municipalities in tapping the vast water resources of the Great Lakes for diversion into the Mississippi waterway.

We are greatly disturbed at the prospect of Federal preemption of rights which have historically, legislatively, and judicially been the rights of the States.

I would like to use one example that I do not have typed in here of an illustration, and this has to do with some of the problems that are, as you stated before the recess, that some of these water problems are much more serious in the Western States. Some of the Federal authorities are claiming that water that originates on Federally owned land belongs to and is under the control of Federal authorities even though it runs over State land in the process of going from where it originates to where it eventually comes to.

I might point out if they want to control it they ought to keep it on their own land. I do not know. Anyway this creates a problem when it runs over State land.

Senator HART. It might create quite a problem if they did trap it too.

Mr. WIGHTMAN. That is true. We would point out that there is no allwise power in Washington that would permit the development of water laws that would effectively serve the 50 States in their many uses and in the development of this essential commodity.

We want to merely state that this is a complex problem and that there are things that the Federal Government should do and will have to do, but they cannot be probably all solved on the Federal basis. They are of some importance to the States.

Thank you.

Senator HART. Thank you, Mr. Wightman.

Before you leave I wonder if it is possible to pinpoint two or three items.

You note that our water table has dropped pretty drastically in certain areas requiring much deeper wells. I am sure that some of the specific exhibits will give me this. But as long as you mentioned it, where in the State is this problem especially acute? Or is it a scattered thing?

Mr. WIGHTMAN. Senator Hart, any statement that I make would not be an authoritative statement because I do not have these figures, but they can be gotten very easily. If you would wish we would be glad to supply them, that is, what we know about them. I do know of specific instances that is, close to where I live, situations of this kind and this of course has to do with farmers. But I know a farmer who put down a 10-inch well for irrigation just a little way from me and started pumping about 500 gallons a minute out of this well. It was a good supply of water. He soon raised hob with the neighbor's wells that were close by. This is one situation.

I also understand, but I have no authoritative statements on this, in the Kalamazoo area there are vast amounts of water being used in industry in that valley but the water table gets lowered quote drastically there, but I have no figures to prove my statement.

Senator HART. But you do know the situation in Fennville and that would be in the southwest corner of the State?

Mr. WIGHTMAN. Yes. That is this one statement I made. I do not know that we have any serious problem in Fennville. We do have one industry that uses a lot of water there but it has not created any serious problem up to now because there is only one industry that really uses water.

Senator HART. I think I should respond to the concern which you express and which I know all of us entertain, that there should be a presumption from the fact that this committee is exploring the question that we intend to move in a massive assault on other units of government with respect to water. Knowing the composition of the committee I am sure that that is not in the mind of anyone. It certainly it not within the charge of the scope as the Congress created the committee. I think the nature of these hearings indicates that there is an awareness at all ends of the line from Washington down to the board of supervisors, locally, that this is a problem which all of us share together and which each of us is required to participate in if we are to manage it effectively.

To use a word which grates on the nerves of some, including me, this grassroots approach is exactly what we are trying to do in hearings of this sort. We do know that water which once could be treated by a landowner in any fashion he wanted, cannot be treated that way any longer. But the extent to which the control should be imposed at every level is something that will always be subject to inquiry, adjustment, and concern.

Thanks very much.

Mr. WIGHTMAN. One other statement, Senator. This is an illustration.

One reason that we get into controversy from a farmer's viewpoint and one reason why we get resistance that sometimes may be more than we might need is exemplified by this illustration. One superhighway that was being constructed and one that I travel on had this problem. The draining on the highway was not low enough to take

care of the drainage of the tile under drain systems of the farms that it passed through. Now, of course, this always takes activity on the part of people who have invested quite a sum of money in this kind of a drainage system. These are some of the problems and these are one of the reasons why we do build up resistance to certain activities though we are not against highways. We know they have to be built although they sometimes tear up farms.

Senator HART. You mentioned one thing of which we in urban centers are, I think, not as aware as we should be; and which is a pretty dramatic example really of what State, local, and Federal cooperation can do for a very low cost. You mentioned the soil conservation district, and right in your own neck of the woods, the St. Joe River district. I went around there for a half day a couple of weeks ago. This, I think, is a very effective demonstration of the respective roles government should play in a given situation, and the resolution that you include in your statement for the farm bureau I think is excellent.

Mr. WIGHTMAN. Thank you, sir. My purpose was to emphasize that farmers have an interest in soil and water conservation—that they know most of the things. And I think almost all of the things I mentioned in this statement here have been mentioned before this morning by various people. But farmers do have an interest here and they are greatly concerned and will be active in helping legislation, whatever it is; and of course opposing legislation, if they think it is going to be harmful.

But I thank you.

Senator HART. Thank you.

Mrs. Howard Lichterman, of the League of Women Voters of Michigan.

Is Mrs. Monroe with you?

STATEMENT OF MRS. HOWARD LICHTERMAN, PRESIDENT, LEAGUE OF WOMEN VOTERS OF MICHIGAN

Mrs. LICHTERMAN. She is here.

Senator HART. Why don't you introduce her?

Mrs. LICHTERMAN. Do you wish me to?

Senator HART. I could do it, but why don't you?

Mrs. LICHTERMAN. I am Mrs. Howard Lichterman, president of the League of Women Voters of Michigan.

Also I would like, since these hearings are being held in Detroit, to introduce to you the Detroit representative, Mrs. Irene Monroe, the president of the League of Women Voters of Detroit.

Is she in the room now?

Senator HART. I saw her here before lunch. I know she has been here all morning long.

Mrs. LICHTERMAN. Senator Hart and members of the committee.

First, I do want to say how privileged and happy the league is to be here today. We are very very grateful for this opportunity. The 3,500 members of the 28 local leagues of women voters in Michigan are, along with the 126,000 members of the League of Women Voters in all 50 States and the District of Columbia, currently engaged in a study of our Nation's water resources.

The problem of meeting the increasing demands on our water supply, while at the same time preserving our resources for the future, is as acute to the league as it is to this committee. I am here today, therefore, to point up what our members are finding are some of the problems we face in Michigan, as well as areas where solutions will have to be found on a national basis.

The most important development affecting the future of the Great Lakes-St. Lawrence basin is the population explosion in the United States, and the concentration of population in the northeastern-midwestern urban-industrial area, of which Michigan is a part. This certainly affects plans for future water needs of industry, population, and agriculture. According to the U.S. News & World Report of July 19, 1957, 45 percent of the total growth of the Nation's population between now and 1975 is expected within the 15 percent of the land in this urban-industrial area. The Census Bureau forecasts a population of 14 million for Michigan 25 years from now, compared with 7,866,000 population on July 1, 1958. There will be continuing concentration in the southern Lower Peninsula.

We can anticipate that there will be increasing use of Great Lakes waters for industry and population, perhaps with additional requests for diversion to water shortage areas outside the basin. The capital investment for filtration and sewage treatment plants will be considerable and, if past experience is a guide, there will be a continuous lag in needed facilities.

Of concern to the States bordering the Great Lakes, though navigation is not yet seriously damaged, is that additional diversion of our waters by other areas without its return, if continued and extended, could set a precedent that would result in more difficulties due to the lowering of the lake levels.

The Great Lakes basin is the storage area for the five lakes. The watershed covers 298,000 square miles, of which nearly one-third (95,000 square miles) constitutes the water surface of these five lakes, Lake St. Clair and the connecting waters. In Michigan we are confronted with relations with other States in the use of this water. The United States is vitally interested because of our international relation with Canada. Even in an area where there is such an apparent abundance of water, the varied and many needs cause conflicts to arise.

The demand for use of recreation areas in Michigan will undoubtedly continue to grow. There is a recognized need for land acquisition, especially Great Lakes shoreline. It is estimated that recreation will be the No. 1 use made of all State and Federal lands in Michigan. (G. Robinson Gregory in "Forestry Ahead—The Challenge," in "The Michigan Conservation," July-August 1959, vol. XXVIII, No. 4, p. 8).

At the same time watershed and wildlife management values must be conserved and the forests themselves protected if they are not to lose recreational deisrability. With population increasing at an explosive rate, shorter working hours and natural water sites becoming occupied, the need for positive recreational planning in water development will be imperative.

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Supplemental irrigation is coming to the eastern part of the country, where formerly it was just a curiosity. Its expansion into the regions where the largest cities and the heaviest industrial use will continue to be located must inevitably create competition for both local and regional supplies. While Michigan's agriculture does not yet depend greatly upon irrigation, irrigation has been increasing in Michigan at the rate of about 10 percent a year. At present, about 68,000 acres are irrigated, but compared to the approximately 18 million acres in agricultural production, it is still quite small. However, the urban-industrial development is encroaching steadily upon our best agricultural lands. This may possibly mean more intensive use of agricultural lands left, with irrigation to enhance the yield. It is expected that there will be an increase in dairying to meet the needs of the population.

The pollution of Michigan waters, and attending need for increased sewage treatment and water purification as the population continues to grow; indeed the question of actual availability of an adequate supply of water to meet human and industrial needs is perhaps the greatest single problem faced in this State today. The future of many industrial and residential areas rests upon preserving and improving available water supplies. New users of streams for waste disposal have to show that they will not harm the waters.

Pollution is also a source of potential international conflict in the Great Lakes-St. Lawrence Basin. Waste disposal at locations where injury could reach the neighboring country's border calls for careful control and attention by the Governments of both countries and their States and Provinces. (Recently Mackinac Island was accused of emptying raw sewage into the waters of the straits. Other areas within the Michigan scene which are sources of potential conflict are the St. Marys, St. Clair, and Detroit Rivers.) Further pollution has developed because of ships sinking in the waterways. We are concerned also over the possible effect of nuclear ships—such as the *Savannah*—scheduled to be launched in 1961—on our waters. Careful study should be made of whether atomic wastes from such ships will contaminate the water. It is vital to continue and stimulate research in the whole area of pollution control.

There is not a single use that can be made of our water supply that does not affect in some way at least one (and often more) of the possible uses that can be made of these resources. With a steadily growing population and a constantly increasing utilization of our water, these conflicts of use multiply. Such conflicts must be resolved. Up to the present, conflicts in demand for the total water use have not been sufficient to bring about comprehensive development of principles for allocation of water or establishment of State agencies to administer them. But sooner or later there will have to be comprehensive legislation for control of water due to the competitive uses. Hopefully this legislation will result from advanced thinking and planning, rather than from court action based on necessity of settling conflicts.

While we have no specific solutions to offer at this time, it has become increasingly evident to leagues all over the country that, in order to preserve our water resources and at the same time meet the increasing demands upon these resources, improved coordination and planning at the regional or river basin level is essential. There have been many

such proposals. Throughout the country, leagues have been finding that coordination is proceeding fairly rapidly at these levels. However, existing river-basin or interagency commissions have limited objectives and are unable to initiate planning and coordination at a sufficiently early stage. (The Great Lakes Basin compact, still lacking congressional approval, would provide for a consultative and recommendatory agency.) The league recognizes the need for suitable machinery to provide for orderly and effective cooperation among all levels of government.

It has become increasingly alarming to note growing indications that communities are outgrowing their ability to handle pollution and sewage problems. We are disturbed at the impasse arrived at when one or several communities can stymie a proposed project by not voting to pay their share of the cost. (This situation is occurring at the moment with the proposed—but still blocked—construction of the Twelve Town drain.) Would it not help all communities to plan for the future—and all regions too—if more equitable financing standards were developed? The league would like to see more uniform ground rules for such things as project evaluation and repayment of costs.

Plans for the future of the water resources of our country can be adequately formulated only if there is coordination of administration of the various water programs and Government agencies; since the water situation of one region, by its very nature affects the water situation in other regions. In Michigan, long-range planning is esesntial to protect the water level of the Great Lakes. Advance planning of land use is crucial in the whole East to keep the flood plain level, protect future reservoir sites, and provide for the use of water—especially in heavily populated areas. Development of the ports of Michigan should be investigated by all avenues—private, local, State, and Federal—to insure that we are making full use of our potentials.

We would like to see adequate information made available to enable Congress, and citizens too, to make intelligent choices between possible alternatives. The League of Women Voters of the United States has given support to Senate bill 2549, the Resources and Conservation Act of 1960, introduced into the Senate by Senator Murray, of Montana, last August, and sponsored by 31 Senators, including Senator Hart, of Michigan. This bill sets up machinery to help solve problems in the natural resources field. It sets up a White House Council of Advisers and a joint congressional committee, to give continued informed attention to the needs and capabilities of the Nation in this field. It would also establish a national policy on natural resources. To us this is a proper and necessary advancement.

We, in the League of Women Voters, feel that this Senate select committee is already helping tremendously to develop a better understanding of the complex problems involved in water administration and of the possible choices that can be made to their solution. We anticipate that its recommendations will bear this out.

Thank you.

Senator HART. Thank you very much.

I hope the committee is making a contribution, but I know this: because these actions which you point out and others have pointed out today are not easy roads, the broadest possible public understanding

of the basic problem will be essential, if we will find more than half in a legislature willing to take the tough road. That is the contribution the league so effectively can make not alone in this field but in other fields also.

Thank you very much.

Mrs. LICHTERMAN. I would like also to give this to you. I have chapters of our "Know Your River Basin Study." It is not completed. The whole study is not yet in completed form. I am presenting to you now two chapters along with two other things.

Senator HART. Thank you. That may become a part of the record.

Mrs. LICHTERMAN. Thank you, Senator Hart.

(The material referred to follows:)

BACKGROUND FOR FEBRUARY UNITS ON EMERGING PROBLEMS IN THE HURON WATERSHED—FORMATION AND PROGRESS OF THE HURON RIVER WATERSHED INTERGOVERNMENTAL COMMITTEE

(Prepared by the Ann Arbor League of Women Voters)

I. ROLE OF THE WASHTENAW COUNTY PLANNING COMMISSION

February 1947: Planning commission set up by the Washtenaw Board of Supervisors to advise on problems of growth and prepare a long-range plan for the county. Water resources were soon recognized as a basic factor in determining character and location of future development. The commission realized that land-use planning and water-use planning must be coordinated, and this had to be done on a watershed basis.

November 1956: Sanford Farness, director of the commission, called together 25 representatives of various State and local agencies concerned with the Huron River to become a basinwide advisory committee. At subsequent meetings an outline of desirable basin surveys was approved. The State water resources commission agreed to compile and analyze hydrological data.

October 1957: The water commission submitted its report, entitled "Water Resource Conditions in the Huron Basin." This identified several sites where reservoirs could be constructed to augment low streamflow and recommended the establishment of a watershed organization to define water-management objectives and study the various possibilities for attaining them.

February 1958: The Washtenaw County Planning Commission invited representatives of the four counties and the townships, cities, and villages within the watershed to a meeting to consider taking over responsibility for further studies of the Huron. From this group a temporary committee was formed which proceeded to organize a permanent and legally constituted committee.

II. ORGANIZATION OF THE HURON RIVER WATERSHED INTERGOVERNMENTAL COMMITTEE (HRWIC)

April 1958: Permanent committee established under Public Act 200 of 1957 which allows incorporated political units to unite for the purpose of studying area problems. Thirty-two units have joined HRWIC and pledged financial support.

An executive committee was elected and authorized to appoint a technical advisory subcommittee composed of engineers, planning officials, and university professors.

HRWIC has no authority to engage in operating or management functions. It can only study and advise. Having no taxing powers, it must depend on appropriations from member units or contributions from other sources to finance the studies it sponsors.

III. STUDIES UNDER CONSIDERATION OR IN PROGRESS

1. Reconnaissance of water-management needs in the Huron River watershed

The first action taken by HRWIC was to submit a proposal for a board "reconnaissance" study to the Southeast Michigan Metropolitan Community Research Corp. with a request for financial and technical aid. As the corporation is still in the process of organizing, no funds from that source have been forthcoming.

However, the proposed study plan is serving as an overall guide while HRWIC proceeds to undertake such segments of the study as opportunity invites or urgency requires.

2. Appraisal of ground-water resources of the Huron River watershed

Last summer when the Geology Department of the University of Michigan offered to undertake a study of ground water in this region, HRWIC voted $500 to cover half of the expenses, the county planning commission having agreed to pay the other $500. An analysis of past and present uses of ground water will be made, all existing well logs will be compiled, and ground-water aquifers now in use will be evaluated. The study will recommend new areas of potential ground-water supplies and will show the relationship of ground to surface water. This study particularly concerns the upper section of the watershed.

3. Lower Huron River study

The more immediate problems are concentrated in the lower section of the watershed where growing population and industrial expansion are putting great demands on the river. The capacity of the stream to carry increased loadings of sewage effluent and still be usable for such other purposes as water supply and recreation is of concern to the State health department. When Ypsilanti, Ypsilanti Township, and Belleville each submitted plans for greatly expanded sewage treatment facilities, the health department withheld approval of individual projects until an "areawide" plan for the use of the river should be presented. "The essential problem," the department has said, "is to bring about the most appropriate and compatible intercommunity uses of the river." Meanwhile some construction of new homes and industry has been delayed, much to the distress of the communities affected.

The urgency of the situation made action on the part of HRWIC imperative if it was to meet the need for which it was established. Consequently in August the 10 cities and townships from Ann Arbor to Flat Rock agreed to constitute themselves a lower Huron subcommittee in order to sponsor a study of prospective demands upon the lower river and alternative ways of meeting them. The technical advisory committee was asked to draw up a prospectus, negotiate with several engineering firms and obtain estimates of cost. It recommended the firm of Black & Veatch, of Kansas City. Final approval was given at a joint meeting of HRWIC, the subcommittee, engineers from Black & Veatch, and representatives from the State water resources commission and the health department. The latter expressed confidence in the firm and gave assurances that the study proposal met their requirements for long-range planning and would serve as a basis for an immediate solution of the current impasse.

Now all that prevents the study from getting underway is raising the money. The upper cost limit is $35,000, half of which is to be contributed by the members of the subcommittee and the other half solicited from industry. So far 5 of the 10 communities have pledged their share and the Huron Clinton Metropolitan Authority has indicated willingness to contribute.

4. Agricultural water survey

The assistance of the U.S. Soil Conservation Service is being sought for a survey of the relative future importance of agriculture to the basin's economy including prospective needs for irrigation, drainage, land treatment, and possibly upstream flood control in subwatersheds. Although the Huron basin is too large to qualify as a small watershed under the Watershed Protection Act, section 6 provides for the cooperation of the SCS with other agencies in developing coordinated plans for river basins.

5. Report on flood conditions

The U.S. Corps of Engineers held hearings at Flat Rock in March 1949 on the extent of downstream flood damage but no further steps were taken. Now the HRWIC has requested the corps to report on its findings.

6. Other problems requiring study include fluctuating lake levels, recreation, and such broad aspects as watershed administration, finance, and planning.

KNOW YOUR RIVER BASIN

CHAPTER II—WATER USE AND CONTROL PROGRAMS IN MICHIGAN

(By Detroit League of Women Voters)

A. SUPPLY

Michigan's water supply problems are largely financial. Extensive shorelines on four of the Great Lakes bring these vast reservoirs of fresh water within 90 miles of any community in the State. Without this resource the State's future growth might conceivably be limited. In 1953, Michigan ranked sixth among the States in amount of water used for manufacturing. Where water use has been restricted this has been the result of inadequate pumping or distribution facilities.

Natural water resources

In addition to the Great Lakes, Michigan has 11,000 inland lakes and 36,000 miles of streams. However, these small bodies of water vary in quantity and availability; and often become unsuitable for use because of sewage and industrial waste especially at low-flow stages. At present 60 percent of the State's population depends upon the Great Lakes or connecting waters for supply and this percentage increases each year.

Depletion of ground water resources is not yet a major problem in the State; but, ground water supplies are relatively limited in quality and availability. In many areas geological conditions limit the development of ground water. This has been particularly true in the southeastern metropolitan area. In addition, rock formations of the Michigan basin are salt-bearing unless these rocks are porous enough to leach out from penetration of surface water. As a result of these factors intensive local development may result in a gradually lowered water table and upward migration of salinity. Other than the legislation requiring plugging of abandoned oil or gas wells, no Michigan statute requires plugging of abandoned wells and test wells which leaves ground water unprotected from salt water contamination. Salt wells and coal borings of earlier days were left unplugged permitting saline waters to encroach into the fresh-water formations. In a few areas this has virtually eliminated ground water supplies.

Basic data needed

There is a great need for more adequate basic data on ground water resources in the State. Because there is no State legislation requiring well records or licensing of well drillers, much valuable data is being lost each year. Although an estimated 30,000 wells are drilled each year, there are only about 24,000 voluntarily submitted well logs on file in the Geological Survey Division of the Department of Conservation. Several attempts at legislation to require well records have failed of passage.

The U.S. Geological Survey and the Department of Conservation Geological Survey Division cooperate in ground water investigations and an observation-well program is maintained in 288 locations in the State for study of water quality and level measurements. This work is financed by the Federal and State Governments on a matching basis. At times it has been stalled due to the failure of the legislature to appropriate sufficient funds and again because of economy moves at the Federal level. The total amount appropriated for the GSD in 1957–58 was $417,089, of which $50,000 was spent in cooperative geological research projects.

Information from the test wells demonstrates that water levels are continually fluctuating with seasonal changes in the rate of withdrawal and recharge by precipitation. Ground water recharge occurs principally during the nongrowing season; hence, the amount of fall and winter precipitation and the date of ground freeze are important factors. Precipitation during the growing season is required to meet evapo-transpiration needs. In years when record pumpage coincides with subnormal precipitation, very low water levels may be recorded.

Existing water systems

As Michigan's population concentration is heaviest in the areas where ground water is least abundant, three large water systems dependent upon a Lake St. Clair source have developed in the Detroit metropolitan area and account for 98 percent of the usage there—Highland Park and the Grosse Point communi-

ties. The remaining communities in the southeastern area utilize ground water or the waters of the Huron, Clinton, and Flint Rivers. A few large industries have developed their own ground water supplies.

There is continual pressure on existing systems in the rapidly developing areas in the State. Some cities have been able to develop adequate ground water resources—Lansing, Jackson, Battle Creek, Pontiac, and Kalamazoo are among these, although record pumpage has been the rule for these communities in recent years. Ann Arbor uses the Huron River and supplements with ground water. Flint, which depends on the Flint River, and Genessee County communities, which use ground water, are exploring the possibility of a pipeline to Lake Huron. In Ypsilanti and the Huron River area, ground water supplies have been successfully augmented by induced infiltration from streams, as the geological formation permits this.

Ludington, Cadillac, Traverse City, St. Ignace, and Sault Ste. Marie are among the cities faced with the necessity of installing filtration plants or of obtaining ground water supplies from a different source. Saginaw, Bay City, Midland, Grand Rapids, Port Huron, and Muskegon have already turned from ground to surface supply. In Kent and Ottawa Counties, the Kent-Ottawa Authority plans a 54-inch pipeline to Lake Michigan which will serve seven municipalities and townships in the Grand Rapids metropolitan area. Holland proceeded with a Lake Michigan pipeline in 1957 when investigations revealed a rapidly receding water table and no abundant supply in any other area.

Detroit metropolitan area

In Michigan, the Detroit water department is by far the largest system, representing a capital investment of $260 million and pumping water from Lake St. Clair to 42 communities, comprising close to 35 percent of the State's population. It wholesales water to the Wayne County water department, which has a capital investment of $8 million and a distribution system serving 28 communities. The Wayne County department is in the midst of a $54 million expansion program. The southwestern Oakland authority also purchases water from Detroit and distributes it to eight communities. Capital investment is $7 million.

The methods for meeting all of the needs for water in this metropolitan area have been hotly debated in the past few years. Negotiations have been undertaken to permit the city of Detroit to purchase the Wayne County system and to guarantee water supply to southwestern Wayne County. This merger plan is nearing approval by the Wayne County Board of Supervisors and the Detroit City Council. The merger is seen as a first step toward a 10-county water development program in southeastern Michigan which could involve a pipeline north to Lake Huron.

The Michigan Water Resources Commission has proposed a study of the creation of a single metropolitan district encompassing the southern half of the Lower Peninsula to administer all public water and sewage problems. It has also proposed that wholesale water and sewage rates be brought under the jurisdiction of the public service commission or a new State board.

Going beyond this, in 1958, Wyoming Township in the Grand Rapids area proposed three 96-inch mains crossing the State east-west to be linked with north-south mains which would make Great Lakes water available to the State's interior. Financing was proposed by State authority with the Federal Government sharing the cost.

Administration and finances

Michigan is a public water supply State with 80 to 85 percent of the population served by approximately 700 municipal or community water utilities. Financing of these systems has been local—through bond issues, user rates and taxes. Administration is also local. There is no rate regulation at the State level. The State health department approves sites and issues construction permits for public water supply wells, supervises public water supply plans, construction and operation. It also provides information and advice on public water supply projects, and promotes the development of such supplies. It analyzes water supply samples for bacteriological purity and mineral content and interprets the results for the general public. In addition to work on ground water resources, the Geological Survey Division cooperates with the State health department and other agencies in finding and developing suitable supplies of water for State institutions, parks, municipalities, public agencies, and industries.

Rapid growth in the State since World War II and a marked shift of metropolitan population to the suburbs has taxed the capacity of existing systems and created acute problems in fringe areas where no distribution facilities exist. Existing water departments have the authority under the Revenue Bond Act of 1933 to finance needed expansion but have often been reluctant to raise rates to cover increased capital costs. In the last 30 years, legislative acts have been designed to help in development of water utilities outside established cities. County and metropolitan authorities have been authorized to own and operate water facilities, to sell revenue bonds, and to finance costs through user rates and taxes.

Financing remains a problem in rapidly growing and extensive suburban areas, particularly in townships. The water resources commission has recommended legislative revision of the Plat Act which permits urbanized development to take place in rural areas with the fundamental needs of water, drainage, and sewage being met. In 1957, two legislative acts permitting authority financing by general obligation bonds to be paid by taxes and townships were included among those units of government which could contract with the county for water supply financing. Subsequent Supreme Court decisions cast doubt upon a township's constitutional eligibility to be classed as a municipal corporation and thus to disregard the 15 mill limitations.

Difficulties will probably continue in fringe areas as long as reliance is placed on general taxes collected from an entire area or political subdivision to supplement rates collected from only a portion of the area. Service to new and extensive suburban areas requires installation of new transmission lines. Because of the large suburban lots, revenue per lineal foot of main is lower and the longer pipelines required result in increased maintenance problems and costs. In some States, revenue in addition to user rates has been sought in an effort to meet this problem. The annual front-foot charge, which spreads the capital cost over all properties in an area, is considered the most effective but this is unconstitutional in Michigan. Ann Arbor, in 1956, adopted a customer-benefit charge which permits new customers to tie into an existing system upon payment of a lump sum—$75 in the case of a single family dwelling.

B. WATER POLLUTION

Pollution is a statewide problem in Michigan. Its streams, rivers, creeks, lakes, and even ground waters are affected. The steadily growing population, the increased industrial activity, and the ships that sail the Great Lakes all do their share to contaminate our waters.

Locally, the Rouge River is polluted by chemicals, the Raisin River receives oxygen-consuming materials from the paper industries, and the St. Clair River receives considerable sewage and industrial wastes. The Raisin and Maumee Rivers contribute to the turbidity and pollution of Lake Erie at times of heavy rainfall, but this does not extend for many miles offshore.

The areas' surrounding metropolitan centers have presented great problems because they have been allowed to develop, under the Plat Act, without providing drainage, sewage, and sewage treatment. Rapid residential and industrial growth has, for the most part, taken place in the townships which are not accustomed to providing municipal facilities. They must now find some way to provide financial investments much like the incorporated municipality.

Michigan Water Resources Commission

The Michigan Water Resources Commission was formed 10 years ago to combat the increasing waste of our water resources. It has been an effective instrument for the control of pollution. The commission cooperates with the four major State departments, whose heads comprise the ex officio membership of the group. It makes surveys, studies, and investigations of the uses of the State's waters. It inspects water works, sewage systems, and their method of operation. If they are inadequate, they must be improved. All industry must inform the commission of any new or increased waste disposal that may reach either surface or underground water.

The commission makes annual industrial pollution status reports. For the year ending April 1, 1959, there were 400 industrial plants presenting 449 problems:

278—ratings adequate
92—control provided—adequacy undetermined
15—need for control undetermined
8—control facilities available, protection found unreliable
2—municipal treatment facilities utilized—industrial overlooked
42—existing control inadequate or incomplete
12—no control

Sanitary sewage data—district No. 1

District No. 1 was organized in October 1946. It consists of seven southeastern counties: Lenawee, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne, with an estimated population of 4,200,330, or 55.89 percent of the State's 7½ million people (1956). There are 3,375,988 persons served by central sewage treatment facilities. Another 79,608 persons will be served by plants under construction or interceptor construction planned to use existing facilities. In addition, 59,966 persons will be served in the near future by plants under active planning. Thus approximately 3,455,596 persons, or 82.27 percent of the total population will be served by sewage facilities. There are 31 communities of 400 persons or more, 63,074 persons, or 1.5 percent of the population, without sewage facilities. There are nine towns of more than 1,000 but less than 2,000 without sewage treatment. Another nine towns of two to three thousand population fall in this category. Three towns of three to five thousand population do not have treatment facilities. Two of these towns are planning facilities and construction will begin soon. The other has engineering studies underway. Two cities of over 20,000 population are without treatment. One is in default of a commission order and construction will start soon. The other is actively planning and construction depends on its cooperation with several neighboring communities.

Federal grants

In 1956, Congress passed the Federal Water Pollution Control Act which authorizes grants to State, interstate, municipal, or intermunicipal agencies to aid them in meeting the cost of building new sewage treatment plants. Individual grants cannot exceed $250,000, or 30 percent of the estimated project cost, whichever is smaller. The water resources commission allocates the grants on the basis of financial need and pollution control need. Michigan's share of this year's appropriation is $1,394,550. There are 44 applicants seeking a share of these funds for their projects. This act has helped finance 30 Michigan sewage treatment plants.

C. FLOOD CONTROL AND BEACH EROSION

The flood problems in Michigan are not serious in comparison with those of the country at large. Such damage as does result from occasional floods is usually due to some natural or artificial reduction of the carrying capacity of the natural floodway. Michigan's most serious flood problems are in the Saginaw, Grand, and Kalamazoo River Basins. Major floods occur at all seasons. Conditions are generally most favorable for floods in early spring but widespread heavy rains can and do produce floods at any time. The average annual flood damage, not including agricultural loss, is $1.5 million (1954 figure).

The only present legal means for dealing with floods are the drain laws. The Michigan Water Resources Commission studies records of past floods, encourages appropriate zoning, and works with the U.S. Geological Survey material on stream gaging. The commission staff also works with the Federal agencies that survey Michigan flood problems and with the cities, townships, and other units of government that must help pay for the work if a Federal flood project is undertaken.

Federal aid

Federally aided control projects are in some stage of development on many of our rivers. The Corps of Engineers is the major Federal agency involved in flood control work in the State. Their chief means for control recommended by the corps to date has been the deepening and straightening of channels and the construction of retaining walls where necessary. Michigan's topography, land use, and streamflow limits the type of structures which can be employed. Sites for large storage reservoirs are not available and use of lakes

for storage is restricted by the heavy recreational development. There have been recommendations for a great number of small reservoirs including small natural and artificial lakes with their operation carefully coordinated. This has not been attempted in an organized fashion but present trends in development of farm storage ponds may be a step in that direction.

Federal aid through corps projects on the Sebewaing, Clinton, Red Run, and Kawkawlin Rivers totaled $2,511,220 for construction and $20,233 for maintenance through December 1958. The Corps estimated that flood loss equal to $437,000 has been prevented by these projects. Underway in the Kalamazoo project for which the estimated Federal contribution is $5,453,000 and the local, $2,938,000. The corps is also conducting preliminary flood control surveys on the Au Gres, Grand (and its tributaries), Huron, Nine Mile drain, and Carlow ditch (Macomb County), Rouge, Saginaw, St. Joseph, and Sturgeon Rivers.

Michigan drain code

The State drain code was revised by the legislature in 1956 to enable adjoining counties to work together for purposes of flood control or drainage. Three or more contiguious counties can petition the director of agriculture to establish themselves as a water management district. Such a district is authorized to construct, clean out, relocate, widen, deepen, straighten, tile, or otherwise improve its intercounty drains. The subscribing counties are assessed to pay the cost of any projects undertaken.

The revised code also authorizes cooperation with districts in adjoining States for flood control and drainage projects with participating counties sharing the costs.

Under this code, and subject to the consent of the State and county boards of supervisors, the Federal Government is granted the right to use all the easements and rights-of-way in any drain constructed by it in connection with any Federal flood control project. The costs for these projects would then be carried by the Federal Government.

Wayne County drain and flood control program

The duties of the Wayne County drain commissioner are threefold:

1. To locate, establish, widen, deepen, and extend, and have jurisdiction over all drains and water courses within the county.

2. To have jurisdiction jointly where drains are located partly within Wayne and other counties.

3. To compute the cost of construction of drains, to apportion and make assessment rolls for collection of same.

The two phases for protection from floods in Wayne County are controlling the Rouge River and its branches and the construction of sewers and drains. At present the Rouge River is being surveyed by the Corps of Engineers as a preliminary step to construction. The survey is to be completed by spring of 1960.

Beach erosion

In Michigan the cyclical levels of the Great Lakes present a problem to shoreline property owners. At low levels the lakes recede a considerable distance from their waterfront property. At high levels septic tanks are flooded, wells contaminated, and buildings undermined. At the time of high levels in the early fifties there was consirable demand that something be done to protect shore properties. The lakes have subsided by 3 feet since 1952 with a subsequent loss of interest in the problem along the waterfronts. The MWRC maintains that the erosions lull does not mean safety for the properties perched on lakeside cliffs which, through a natural process, "will ravel off to their natural angle of repose." The commission has recommended that local units of government provide guidance in proper waterfront development by enacting and enforcing appropriate zoning measures—for which they have full authority.

The commission has given considerable study to this problem and has worked with the University of Michigan engineers in developing methods to control erosion. Erosion control works may be seen in many places along the Great Lakes' shores; i.e., the Ludington State Park shore.

The Corps of Engineers has undertaken a study to determine the advisability of providing beach erosion control in the vicinity of St. Joseph. The cost has not yet been estimated. The corps has also been authorized by Congress (1952) to make a survey of the lakes for regulations and to determine the effects of such regulations upon navigation, power development, and other water resources; and

the advisability of adopting local protective flood control projects for shore areas subject to inundation as a result of fluctuating lake levels.

D. IRRIGATION AND DRAINAGE

Irrigation and drainage are both used in Michigan to modify the supply of water to meet farm requirements. Irrigation is less prevalent but has been increasing rapidly in recent years. In 1959, there were 70,000 acres under irrigation, mostly in the counties of Berrien, Van Buren, Kent, Manistee, and Calhoun.

Michigan irrigation is supplemental to natural rainfall. Total annual rainfall is not always indicative of the need for irrigation. Scanty rainfall during the growing season may ruin a crop in spite of a normal total annual rainfall. Irrigation practice in the State calls for about 6 inches of application annually, as contrasted with 3 or 4 feet in the Southwest. Controlled experiments and actual practice show increases in crop yields of over 100 percent in many cases. Quality of the product is also improved, land use efficiency promoted, and frost control is facilitated.

Most irrigation systems in Michigan have been developed privately with the cost borne by the irrigator, except for the development of farm ponds. Farm ponds for irrigation are a joint project of the Federal Government and the landowner. The Soil Conservation Service estimates that, on the average, the ponds cost the Federal Government $464 each or about 50 percent of the cost. The 1957 report gives a total of 1,340 farm ponds in the State.

Riparian rights

A potential conflict in water use may be arising as irrigation increases. Many areas of the State have underground reserves too small for irrigation on a commercial scale. Where water is secured from lakes or streams the irrigator may find himself infringing on the riparian rights of others.

There are no statutes or court rulings in this State governing removal of water from lakes or streams, for irrigation, or any other purpose. The riparian doctrine of reasonable use has been the guide. Michigan courts recognize the rights of landowners to sink wells and to pump water for domestic needs and other beneficial uses, following the rule of reasonable use. In August 1958, George S. McIntyre, State agricultural director, asked the legislature to declare farm irrigation to be a "reasonable use" of water. On November 25, 1957, the attorney general gave the opinion that the water resources commission has authority to make studies to ascertain the location and amount of surplus water available for irrigation; but, it does not have authority to receive and act upon petitions for diversion, or to terminate present, or prohibit new diversion for irrigation purposes. Legal rights to diffused surface waters have not been established in the State. It is believed that the courts would regard such waters as the property of the landowner, as is done in other States.

State authorities associated with water use problems see an urgent need for comprehensive legislation with regard to water rights and agree that the direction of statutory change must be toward the doctrine of appropriation under which claims for water use, of whatever nature, may be validated and protected.

In January 1959, a legislative study committee asked for investigation of water supplies and laws to provide equitable distribution. The committee also suggested investigation of development of farm ponds for storage of irrigation water, rather than lowering streams and rivers for that purpose. The committee also recommended that Michigan continue to recognize the riparian doctrine of water use. Mr. McIntyre reported that 62 percent of irrigation in the State is from surface water and said that in many areas of the State farm storage ponds are not possible because of the terrain and necessity of storing amounts which would require vast acreage.

Drainage

The development of agriculture in Michigan was paced largely by its ability to dispose of excess water. Early explorers described the State as one vast swamp. An era of wholesale drainage got underway in the 1880's and did not reach its peak until after the turn of the century. By 1958, 40 percent of Michigan's farmlands were artificially drained by tile and ditches.

The era of drainage brought into being an extensive pattern of open ditches, many of which required community, township, county, and intercounty, and State cooperative action. These projects also involved the straightening and deepening

of natural waterways, necessitating enabling legislation and State support. The Michigan Drain Code of 1956 formulates these laws.

Substantially all of the drainage enterprises were confined to the lower part of the Lower Peninsula where are found the lake clay plains and till plains comprising the State's richest agricultural lands. About 85 percent of the marketed produce come from this Lower Peninsula area.

The Michigan Department of Agriculture drainage figures for 1955 indicate that the State had a total of 26,261 miles of established county and intercounty drains draining a total of 26,779 square miles of land area. This is exclusive of municipal drainage and individual farm drainage. Detroit spends about $10 million annually for storm and sanitary sewers, while farmers are engaged in individual projects which drain some 73,000 acres annually at a total cost of about $6 million of which the Federal Government (agricultural conservation program) through incentive payments provides approximately one-third of this cost or about $2 million.

The drain code provides for a county drain commissioner, but counties under 12,000 population may abolish this office and transfer its duties to the road commissioner. A drainage project may begin with the presentation of a petition signed by 10 names. If the drainage area involves two or more counties, the State director of agriculture receives the petition and notifies the drain commissioners of all the counties concerned. Those commissioners become the drainage board with the director of agriculture as chairman. The land is assessed for drainage expenses, and if need be bonds may be issued. The drain commissioner has power to locate, establish, and have jurisdiction over all drains and water courses in the county and compute the costs and make assessments for these drains. He may appoint deputies and engineers as are needed.

Overdoing drainage

Since the major interest in the past was getting the water off the land, there was little thought of overdoing it. Some of the adverse results were greater runoff, erratic streamflow, muddy streams, silting waterways, and changed acquatic life. Some needless drainage was undertaken as in the Seney Marsh in the eastern Upper Peninsula. Later this project was abandoned, reflooded, and is now maintained as a wildlife refuge. An agricultural problem arose as a result of excessive drainage of valuable muck lands which decompose more rapidly and lose value when drained. With the rising interest in watershed management and greater understanding of these organic soils, greater attention is being given to control of drainage. This is called controlled irrigation because the water level is held up in the soil close to the place where the plant utilizes it. Muck soils may need both control of the water table and supplemental overhead irrigation at times.

Financing of the drainage work was given its impetus by the Swamp Lands Acts of 1849 and 1850, under which wet lands were conveyed to the State on condition that the funds from their sale be used to build drains and levees necessary to reclaim them. Michigan is one of the States most heavily invested in drainage enterprises.

Drainage canals may serve the dual purpose of drainage and irrigation. They may serve as a reservoir for holding irrigation water, and the drain law provides that dams may be placed in drains for the purpose of irrigation.

E. POWER

Power is supplied in the State by 19 private, 52 municipal, and 15 cooperative or REA plants. In the Lower Peninsula, 85 percent of the capacity is generated by the Detroit Edison Co. and Consumers Power Co., private utilities. The State's installed capacity increased by 110 percent from 1947–57 and anticipated future demand in the Lower Peninsula is being planned for with 1.8 million kilowatts to be added by 1961. In the Upper Peninsula, more steam capacity is needed to firm up the hydroelectric power at low water times. Of the 233,612 kilowatt capacity in the Upper Peninsula in 1953, 101,720 kilowatts were in company owned and used plants.

Steam and hydro

Steam plants produce 90 percent of the State's power requirements, utilizing coal delivered by low-cost Great Lakes bulk carriers. Hydroelectric power plays a small but important part in meeting energy needs, helping to meet peak loads and improving voltage regulation. The availability of installed hydroelectric power varies with streamflow which is largely seasonal.

Michigan ranks second among the States in number of hydroelectric plants, but these are relatively small. The terrain does not adapt itself to the construction of large reservoirs, being moderately rolling and with sites good for impoundment usually near the headwaters of streams with small drainage area. Distribution of power sites throughout the State is uneven with none in the "thumb" or the eastern Upper Peninsula.

In 1956, the potential hydroelectric generating capacity in Michigan was estimated to be 692,000 kilowatts, of which 364,150 was already developed. With the best sites in use, investment costs for further development may compare unfavorably with steam. In the field of nuclear energy a $400 million demonstration fast-breeder reactor is under construction near Monroe by the Power Reactor Development Co.

Financing

Except for the REA cooperatives, power development in the State has been undertaken by municipal or private power companies. The 15 cooperatives were financed through long-term REA loans totaling $70,911,945 (through 1957). Repayments on the interest and principal have amounted to $17,602,264 through the same period. Ten of the cooperatives are in the Lower Peninsula, five in the Upper Peninsula. All but two are distribution systems which purchase power wholesale from other utilities. The two generating plants are at Big Rapids (diesel) and Boyne City (steam and hydro).

Regulation

The Michigan Public Service Commission has the authority to regulate private utilities. Its powers do not extend to municipally owned utilities or cooperatives, but the commission may give advice and render assistance to municipal companies upon request. It may prescribe the form of accounts and annual reports for municipal utilities.

F. NAVIGATION

Michigan, with its extensive shorelines, is connected directly with seven other States by navigable waterways and with Canadian ports. This has been economically important because of low shipping costs for coal, oil, limestone, iron ore, grain, wood products, and other bulk materials. The Detroit River passage to the three upper lakes is the world's busiest waterway. The Soo locks are of great strategic importance: during World War II 90 percent of the iron ore used in industry passed through the locks. The present flourishing Great Lakes—oversea transportation industry started in the 1930–33 depression, which stimulated a search for economy in transportation. In 1933 the first regular steamship line of modern times was established between the Great Lakes and Europe. There were 25 oversea lines operating in the lakes in 1956.

Corps of Engineers projects

The U.S. Army Corps of Engineers Report for January 1957, lists 51 projects for Michigan (channels, turning basins, harbor basins, harbors of refuge). Calculated to June 30, 1956, the cost of these improvements was $125,496,002 and maintenance was $66,602,788. The commercial navigation projects are justified on the basis of the economic saving through reduced shipping costs, increased imports and exports, and similar factors involved in shipment of commodities by water. For the fiscal year beginning July 1958, the appropriation for Michigan harbors was over $34 million, including $25 million for channel work.

The harbor of refuge projects are authorized after a benefit-cost study is made by the corps. Benefits must exceed costs, but it is recognized that benefits cannot be precisely formulated.

Michigan Waterways Commission

The commission was established in 1947 to secure cooperation of local communities in meeting Federal requirements for projects and it cooperates with the corps on these. It also actively solicits Congress for appropriations for projects. It has additional functions relating to boat licensing and inspection, vessels carrying passengers for hire, marine safety regulations, and submerged lands. With the exception of revenues received under the tonnage tax, all activities of the commission are financed from taxes on recreational boating (marine fuel tax) and the watercraft license tax. Expenditures for the fiscal year 1957–58 were $1,960,212.

St. Lawrence Seaway

The navigation season on the Great Lakes-St. Lawrence Seaway opens in early spring and closes at a designated time each autumn. Before the seaway was completed only 2,500-ton ships were able to come through the locks. New oceangoing ships are expected to be two to four times that size. The preseaway depth in connecting channels was 21 and 25 feet in the upbound and downbound channels, respectively. A Corps of Engineers project, authorized by Congress, will deepen them to 27 feet in both channels. Estimated total cost for this project is $150 million and the target date is the summer of 1962. The new Poe lock at Sault Ste. Marie has also been authorized at a cost estimate of $35 to $40 million, but awaits appropriation of funds. The corps is also conducting a Great Lakes harbor study, a companion investigation to the program now underway for channel deepening, at an estimated cost of $750,000, and a comprehensive traffic analysis of commerce entering or leaving the Great Lakes through the seaway.

Before the opening of the seaway in the navigation season of 1959, the major part of Great Lakes commerce was in basic bulk comodities—iron ore, stone, coal, and grain. It is anticipated that general cargo shipments will increase as vessels of larger freight-carrying capacity make their way through the seaway.

The seaway is of great economic importance to Michigan and Detroit. Contracts for deep-draft ships have come to Michigan with seaway opening. The port business brings with it increased demand for marketing and distribution development. Before the seaway, income for transfer of cargo between ship and shore was about $10 million in the port of Detroit. Income from ships in port added another million. National statistics indicate that each ton of goods moved through a port means $11.50 in extra business to the community.

Port of Detroit

The port of Detroit, authorized by the State legislature 25 years ago, is the only port district in Michigan. It extends the length of Wayne County. The average annual total of waterborne traffic in and out of the port before the seaway was 23 million tons, or 6 percent of the tonnage handled in all Great Lakes ports. The export-import tonnage in 1958, the last preseaway year, was a record 88,159 tons. It is estimated that this will reach 300,000 tons in 1959. Imports, exceeding exports, were led by finished steel for industry. Other major oversea imports were glass, vehicles, liquor and wine, tools and hardware. Biggest oversea export was animal hides, followed by vehicle parts and vehicles. Cargoes from other Great Lakes ports were coal, iron ore, limestone, machine tools, and other metal trades products, cement, sand, gravel, gypsum, and crushed rock. Shipped out were motor vehicles, parts, motor fuel and gasoline, salt and chemicals, iron and steel scrap, steel mill products, paints and varnishes.

The port of Detroit is administered by the Port of Detroit Commission, consisting of five members elected by the Wayne County Board of Supervisors. Commission powers have been limited to those of a service agency, providing information on shipping costs and traffic movements and promoting port business. The commission has proposed that modern marine terminals and cargo-handling facilities be provided at 3 sites which would give the port an additional 15 berths for the larger seaway vessels. Twice in the last 2 years the commission has unsuccessfully sought voter approval to use public funds for port expansion. Public development is opposed by those who believe private capital can develop adequate port facilities. When the seaway opened in the spring of 1959, the port of Detroit dock facilities were not adequate to handle the immediate demand and the issue of public-versus-private development was again raised. In June 1959, Detroit Mayor Louis C. Miriani set up a committee to focus on the problem of providing additional port facilities.

Other port facilities

In addition to Detroit, developed port facilities are found at Monroe, Port Huron, the Saginaw-Bay City area, and Muskegon, where they are contributing to the industrial growth of western Michigan. Over one-third of all the Great Lakes ports handling a million of more tons annually are in Michigan.

G. WATERSHED MANAGEMENT

Michigan lies directly within the Great Lakes-St. Lawrence Basin. The outlet of all the drainage in Michigan is the Great Lakes (Michigan, Superior, Huron, and Erie) except for a few square miles of the Upper Peninsula on the

Wisconsin border which drain eventually into the Mississippi. The Lower Peninsula has a divide curving through its center and rivers flow either to Lake Michigan or to Lakes Huron and Erie. In the Upper Peninsula river flow north to Lake Superior and south to Lakes Michigan and Huron from an east-west divide. Michigan rivers drain a total area somewhat larger than the State itself. In the boundary areas of the State considerable drainage is collected from areas outside Michigan in Wisconsin, Indiana, and Ohio.

The State contains 23 major river drainage basins which in turn contain the smaller basins of their tributaries. The major basins are: Saginaw, Grand, St. Joseph, Muskegon, Menominee, Kalazamoo, Manistee, Au Sable, Traverse, Manistique, Cheboygan, Ononagon, Raisin, Thunder Bay, Escanaba Huron, Tahquamenon, Clinton, Sturgeon (Houghton County), Pere Marquette, Black (Sanilac County), Rifle, and Au Gres.

Michigan's chief watershed problems have been due partly to excessive logging in the northern areas on soils often not suitable for farming and subsequent uncontrolled fires. Originally forest covered 97 percent of the State. Between 1840–1900 most of the forest in the northern half of the State were lumbered as well as the smaller hardwood forests in the southern half. Fires followed with loss of humus and of topsoil by erosion. A second factor has been insufficient protective measures on farmlands with resulting erosion and loss of water seepage.

In addition to these manmade factors, Michigan's landforms are more complex than those of many States because of glacial origin, and land management is particularly complicated. Ten major land types are distinguished, based on general elevation, topography, soil types and fertility, prevalence of lakes, swamps, streams, and drainage conditions. The State also have great variation in soil types and structures which usually do not occur as uniform types in large areas, but in mixed associations, with various soil types and differences in topography and drainage in a give area. Some areas consequently permit much greater runoff and less absorption of moisture. Agriculturists grade land from class 1 to 8, excellent to unsuitable, according to soil structure and content, slope, moisture and drainage, present erosion, and the amount of conservation protection advisable. A farm, forest land, or watershed may contain many types of landforms.

Farm acreage

The total acreage of farmland in the State, including woodlots, fell during 1940–55 from 18 million to 16.5 million. The area of cultivatable land, not including woodlots, was reduced by 700,000 acres during 1942–56 for purposes only of urbanization, industry, and public developments. Some of the drop in farmlands during this period may be accounted for by abandoned farms, or marginal land not being used. A basic inventory of agricultural lands to be completed in 1965 has been undertaken by State and Federal agencies, but not enough has been accomplished as yet to be of value.

Forests

Cutover sandy soils common in the northern part of the State often proved unsuitable for farming and became tax delinquent. In these areas State and National forests have been established in the last 50 years as well as commercially owned forests. Seventy-nine percent of the land under jurisdiction of the State conservation department was once tax delinquent—about 3 million acres. As of 1954 about 300,000 acres of State forest had been reforested by the forestry division of the conservation department. Much has also been done by private owners, some of it through the stimulus of various public programs. It is now estimated that 52 percent of the State is in forest or woodlots—about 19 million acres. Additional submarginal lands probably ought to be reforested for optimum use and conservation purposes. Reforestation of these lands has greatly aided watershed protection by preventing runoff, building up the ground water stabilizing streamflows.

The forestry division also supplies trees through its nurseries to private individuals and companies. The department's own plantings in 1957–58 were limited by the fact that two-thirds of its trees were sold. Some of this demand has been due to conservation plans of farmers under the soil bank, soil conservation and fisheries division of the conservation department.

The forestry division cooperates with the Agricultural Extension Service and the U.S. Forest Service in the cooperative forestry program in giving advice

to small woodlot owners, commercial timber growers, and others on selective cutting, care of trees, planting, and overgrazing.

Watershed work

In 1950 the fisheries division undertook a pilot project in watershed management on the Rifle River. The impetus for the program was improvement in fishing, but benefits to soil and water conservation also followed. This was a cooperative project of many agencies: Michigan Department of Agriculture, water resources commission, Ogemaw County Road Commission, Ogemaw County Soil Conservation District, U.S. Geological Survey, U.S. Forest Service, and Weather Bureau, and departments of conservation of Michigan State University and University of Michigan. The work was financed chiefly with State funds from fishing licenses, Federal funds from the Dingell-Johnson Act, and to a lesser degree from U.S. agriculture conservation program and soil bank funds. The project covered 180,000 acres—one-third in private ownership and two-thirds in Federal and State ownership.

Much of the program's success is considered due to a policy of allowing public work to be done on private lands, mostly farmland, with little expense to owners except maintenance and with their agreement to permit necessary work and not to disturb or destroy it for 10 years. Upland work consisting of 8 miles of sod waterways, 199,000 tree planting, 7,000 feet of fencing to protect planting, and farm plans with owners for use of farmlands was done. Channel work consisting of stabilization of 133 eroding banks, building a diversion channel, and 106 other stream improvements such as building ponds, spawning grounds, and 7 small dams were also carried out.

The project, which was completed in July 1954, aroused great public interest and contributed not only to fishing but to improvement in management of farmlands, road drainage, stabilization of streamflow, and development of State-owned and wild lands. The cooperation of 75 percent of the farmers was considered one of the chief factors as well as the cooperation of the various agencies. As a result of this project all stream improvement work of the division has now been placed on a watershed basis.

Watershed survey

A statewide watershed survey of rivers was begun in 1952. The condition of streams and rivers and their uplands is assessed; and, if found necessary, a detailed survey is made of drainage pattern, erosion, cover, farming methods in the watershed and other possible factors. If work projects seem advisable and feasible, a plan of upland and stream channel work similar to that on Rifle River is set up in cooperation with the other agencies. The survey is not yet completed, although reconnaissance has been done on enough streams to give priority to certain projects. The biennial reports of the conservation department indicate that work has begun, and in some cases already completed, on 10 river watersheds in addition to that of the Rifle and that plans have been prepared for other streams.

Soil conservation

Also working with farmers on conservation practices is the soil conservation district, a legally established subdivision of the State. A district is set up by petition of local landowners and governed by an elected local board. Its legal functions include working out programs for soil and water conservation, including research, educational work, surveys of individual farm need, technical assistance in carrying out plans, acquiring machinery and other property to conduct programs.

Districts work closely with a State soil conservation committee which coordinates and assists the districts and also with many other local, State and Federal agencies in order to secure technical assistance and carry out the program. A district may not borrow or levy taxes. The program is financed by State appropriations (20 percent production and sale of trees for reforestration, machinery rental, appropriations from county boards of supervisors, and gifts). Various other special programs such as the soil bank, Farmers' Home Administration (credit), and State conservation department with which the districts cooperate also assist by providing their funds to aid farmers in carrying out special plans.

Between 1937 and 1957 Michigan established 75 districts which cover 70 of the 83 counties and about 90 percent of the cropland. However, living within a district does not imply being a "district cooperator." Up to 1958 cooperators

in Michigan numbered 31,520 owning 4,140,200 acres. Of these 18,237 have accepted a basic conservation plan, outlining various conservation procedures and methods for carrying them out. About 16 percent of all farms and 17 percent of the agricultural land within the districts are covered by SCD agreements.

The districts are also assisting in setting up small watershed protection programs under the Watershed Protection and Flood Prevention Act, and as of June 1959, were cooperating on planning on 5 such projects, most of them apparently arising out of flooding of land by stream and poor drainage. These projects are: Little Black River, Sanborn watershed (Devil's River), Mistequay Creek watershed, Muskrat Creek watershed, and Middle Tiffin watershed.

The U.S. Department of Agriculture through its agricultural conservation program and the conservation reserve program of the soil bank also contributes to watershed activities in Michigan by providing funds to farmers. The ACP is a cost sharing plan by which farmers may receive financial help in carrying out conservation plans beyond his financial ability. It is administered through the county agricultural conservation and stabilizing committees with the advice and cooperation of the U.S. Soil Conservation Service, Forest Service, soil conservation districts, and other agencies. Payments were made to 18,543 Michigan farmers in 1957 to provide the same types of farm conservation measures as used by the soil conservation districts—terracing, strip, and contour farming, cover and tree planting, pond and sod waterway construction, drains, and stream channel work. The conservation reserve program of the soil bank, also administered the ACP committees, withdraws land, usually marginal from production for 3 to 10 years, and payments are made to the owners to aid in carrying out conservation practices on the land. In 1958, 169,137 acres were covered by contracts with agreements on the number of acres to be given specific conservation measures.

There is probably considerable duplication in the figures given for these practices over the State by the soil conservation districts, on the one hand, and the agricultural conservation program and conservation reserve program, on the other hand, because funds from the last two programs are often used by farmers in the SCD to carry out their "basic plans."

Small river study

The Michigan Water Resources Commission is also concerned in the field of watershed management and conservation. In 1954, it began, in cooperation with the U.S. Geological Survey, Weather Bureau, and the Agricultural Engineering Department of M.S.U., a study of 4 small river watersheds in southern Michigan. These were planned as sample studies because of little existing information in the State on "rainfall intensity, duration, frequency and resulting runoff" in small agricultural basins, and to demonstrate the need for more such studies. Preliminary reports have been issued for two of the areas, Deer Creek and Sloan Creek, giving detailed information on precipitation and streamflow which can be used for future planning for water supplies and erosion control.

Huron River study

In 1957, because of the concern of the Washtenaw County Planning Commission and other area interests over future water supplies, the water resources commission also undertook a study of the Huron River Basin. This is an area of 892 square miles and has increasing population and industrialization. Detailed records of topography and of water resources from precipitation, lakes, riverflow, and ground water were gathered and interpreted. Information on water use for municipal purposes, recreation, irrigation and industry were obtained. Reservoir sites on tributary creeks were assessed as to capacity, cost, availability in terms of present land use and operational problems. Recommendations were made that, despite substantial water resources in the area, reservoir sites ought to be acquired soon while they are available and economically possible. It was also urged that an intermunicipal organization with legal power to plan, tax, condemn property, purchase, construct, and administer facilities be set up to provide sufficient facilities for future growth, to decide whether reservoirs or other means will be used for future water supplies, and to coordinate upstream resources of the basin with the coming needs of the downstream area.

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H. RECREATION, FISH, AND WILDLIFE

Though Michigan has about 6½ million acres, or 18 percent of the State's area, in public ownership, developed public recreational areas are taxed beyond their capacity, especially in the southern part of the State. Beginning in 1920, the number of people who used the State parks annually has increased from 200,000 to 17 million in 1957. This reflects the great rise in demand for non-urban recreation on the part of an increasingly urbanized population and the popularity of the State's forested lands with residents of nearby industrial States. Of economic importance, tourism ranks as one of the State's major industries, grossing $500 million in 1954.

Most of the public lands are in the northern part of the State away from the heavily populated areas, which makes for an erratic use pattern. There are only 220,000 acres in public ownership below the Muskegon-Bay City line. The department of conservation had no State appropriations during 1957–58 for land acquisition, although there is a recognized need for accelerated and expanded acquisition at all levels of government. The land is available at present, but the shorelines of the Great Lakes are gradually being taken up with private development. In the 1957–58 legislative session, proposals for annual and daily park fees and a $30 million bond issue to provide capital for park improvements failed of passage. The parks and recreation division spent $2,746,462 in 1957–58 (general fund appropriation).

There are 75 State parks and recreation areas administered by this division totaling 178,500 acres. Of these, 54 are well developed and 4 represent areas in the process of development.

Additional recreation areas exist in numerous city and county parks throughout the State, mostly with lake or stream frontage. In the southeastern section, the Huron-Clinton Metropolitan Authority maintains four parks of 5,600 acres which are heavily used throughout the summer.

State forests

The forestry division of the conservation department administers 18 State forests, comprising approximately 2,700,000 acres with campsites and picnic areas available in 99 locations, all with water frontage. Recreation use is becoming increasingly important in forest management; hunting, fishing, hiking, canoeing, camping, picnicking, winter sports, and scenic enjoyment are all taken into account. The State forest campground system is expanding each year because of overcrowding. The number of campgrounds will be doubled within the next few years. It is estimated that in recent years, between 175,000 and 200,000 people used the developed forest areas. In addition many campers prefer unimproved spots of their own choosing, since there are no restrictions on the location of camps in the State forests.

Public fishing sites

Michigan leads all States in number of public fishing sites, 708, and usually ranks first or second in the number of fishing licenses sold. These sites are maintained by the fisheries division of the department and provide public access to lakes and streams. Public fishing sites are purchased with fish license money and with Dingell-Johnson funds (excise tax on fishing tackle), the State matching $1 for each $3 of Federal money. In recent years rising interest in types of water recreation, other than fishing, has put added pressure on these sites and control of the great number of boats launched has become a major problem.

Game areas

The game division of the department administers 59 game project areas in the Lower Peninsula and maintains these as public hunting grounds. Acquisition and development of these areas are financed with hunters' license money and Pittman-Robertson funds (derived from Federal excise tax on guns and ammunition).

Small harbors

Of significance for recreation is the harbor-of-refuge program authorized by Congress for recreational craft on the Great Lakes. There are 15 of these harbors in Michigan.

National parks

Isle Royale National Park, administered by the National Park Service of the Department of the Interior, is a 133,838 acre archipelago lying 45 miles northwest of the Keweenaw Peninsula in Lake Superior. It is a wilderness area, reached by boat from Michigan or Minnesota.

National forests

There are five national forests in the State, administered by the Forest Service of the Department of Agriculture: Hiawatha, Marquette, Ottawa in the Upper Peninsula: Manistee and Huron in the Lower. The forests have an acreage of over 2 million, with 55 prepared camp and picnic sites. It is estimated that over 1½ million people visited the national forests in 1956, including 730,000 campers and picknickers.

Fisheries

State fisheries are important from the economic as well as recreational standpoint. Nearly $2 million is spent each year in the fish management program. The fisheries division undertakes research, develops and maintains public fishing sites, improves lake and streams to increase fish production, maintains fish hatcheries and rearing stations, assembles license information and creel census. The sea lamprey investigation program, started in 1955, has been a cooperative project with the U.S. Fish and Wildlife Service and other agencies. The International Great Lakes Fisheries Commission, since 1956, has been empowered to guide and direct the sea lamprey control work. The ultimate aim of control is rehabilitation of the lake trout fisheries. The Fish and Wildlife Service has also started studies on the alewife. Commercial fisheries are at a low point, the annual catch in 1957 being 23,556,612 pounds, considerably subnormal. The estimated value was $2,536,000.

Wildlife

The game division of the department of conservation is also responsible for the management of Michigan's wild birds and mammals. Work includes research and investigation, maintaining four wildlife experimental stations for detailed research, recommending regulations on hunting and trapping, conducting public information programs, acquiring and administering State game areas, making recommendations for game management on State forests, improving habitat on public lands and furnishing plans and materials for habitat improvement on private lands.

The Shiawassee River State game area is the State part of a cooperative project with the U.S. Fish and Wildlife Service, the Federal portion of which is the Shiawassee National Wildlife Refuge. The Service also maintains the Seney Wildlife Refuge in the Upper Peninsula. Primary purpose of the Federal refuges is protection and dependable food supply.

Michigan lies within the Mississippi flyway for migratory waterfowl and the game division participates with the Mississippi Flyway Council, made up of 14 States, on cordinated surveys, waterfowl banding programs and intensive research projects. This information is used by the conservation department, the council, and the Fish and Wildlife Service in formulating policies and establishing regulations. Shooting season for migratory birds is selected within the framework of the Migratory Bird Treaty (Great Britain, 1916—Mexico, 1937) which obligates the signatory countries to protect ducks, geese, and other migratory birds.

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MICHIGAN IN RELATION TO THE GREAT LAKES-ST. LAWRENCE BASIN

CHAPTER IV

WHAT ARE THE MAJOR CONFLICTS AMONG USERS?

(By Dearborn League of Women Voters and Allen Park League of Women Voters)

The Great Lakes Basin is the storage area for the five lakes. The watershed is 298,000 square miles, of which nearly one-third (95,000 square miles) constitutes the water surface of these five lakes, Lake St. Clair and the connecting waters. In an area where there is such an abundance of water, there are varied uses. Conflicts do arise.

In Michigan, we are confronted with relations with other States in the use of this water. The United States is vitally interested because of our international relations with Canada. Any conflict between the United States and Canada is handled through the International Joint Commission which makes recommendations. The Treaty of 1909 between Canada and the United States provides for the following priority in water rights: (1) domestic and sanitary; (2) navigation; (3) power and irrigation.

The interests we must consider and their interrelation are important to the understanding of the problems involved.

The water levels of the lakes are instrumental in the planned program for control of the waters available. Navigation is a prime factor especially now with the opening of the St. Lawrence Seaway and the resulting increase in commerce. For the benefit of navigation, high lake levels would be best. Based on present U.S. bulk cargo fleet, it is estimated that if all vessels were required to load 1 inch less than their design permitted for an entire season, annual carrying capacity of the fleet would be reduced about 1 million tons. Since navigation is under the control of the U.S. Corps of Engineers, whenever artificial changes are made in the water-carrying capacities of the channels, they are compensated for by appropriate excavations or filling by the corps. In the case of Lake Erie and Lake Superior, compensating work for regulation is by the operation of outlet dams.

Generally damages due to inundation of low lands and to erosion of lakeshore property by storm activity are greater when the mean lake level is high. Thus reduction of high levels would protect (to a degree) against extreme high lake stages but not completely eliminate damage to shore property resulting from inundation and wave action. Also, more recreational area would be available from the additional sand beaches for public and private use. However, too low levels make marine structures unusable.

Hydroelectric power interests can best be served from a uniform river flow with large enough lake storage capacity to insure a high minimum river flow.

Fluctuations on the lakes are divided in to three main types:

1. Long range, varies from 4 feet on Lake Superior to 6½ feet on Lake Ontario. Natural factors affecting this are precipitation quantity and distribution (average 31 inches per year), evaporation (1½ to 3 feet annually) and flow in connecting rivers and movement of earth's crust.
2. Seasonal—high in summer, low in winter. Average range 1.3 feet.
3. Short-range results from unbalanced conditions on lake surface caused by winds, barometric pressures and lunar tides. These can last from several minutes to several days and range in magnitude up to about 9 feet above general level. Sudden rises of 3 to 4 feet are called tidal waves.

DIVERSIONS

Diversions into and out of the lakes affect other uses as follows:

Navigation: Reduced loading of vessels if water level is lowered.

Public water supply: Negligible.

Pollution: Negligible.

Recreation, fish, and wildlife: Loss of recreation land if levels are low. Fewer nesting grounds if levels are low.

Flood control: Less drainage when lake levels are low.

Power: Great loss if additional diversions out of lakes are permanent.

Drainage: Lower lake levels would lower ground water level.

Irrigation: Negligible.

Through international agreement, Canada has dammed certain streams north of Lake Superior that formerly flowed into Hudson Bay and diverted their flow into Lake Superior for power development purposes. This diversion averaged about 7,000 c.f.s. (cubic feet per second) during 1958. The increase of Lakes Michigan and Huron resulting from this diversion has been computed to be about 3 inches for 5,000 c.f.s. (which was the amount originally contemplated for the Lake Superior project).

The only diversion of any significance out of the Great Lakes is that which is made through the Chicago Navigation-Drainage Canal. The present diversion of Lake Michigan water at Chicago (which was established by Supreme Court decree in 1937) is 1,500 c.f.s. for navigation and 1,700 c.f.s. for water supply and sanitation.

This conflict involving the specific use of Great Lakes waters is one of 40 years duration between Chicago and the other Great Lakes States and Canada. Illinois Congressmen have tried to introduce legislation in Congress nearly every session to increase this diversion.

The present disagreement arises over a proposed additional diversion of 1,000 c.f.s. by Chicago. The other Great Lakes States contend that Chicago needs this additional water for sewage treatment and not for navigation and should therefore construct more efficient sewage treatment facilities so that additional water from Lake Michigan would not be needed.

The U.S. Corps of Engineers has made a study of the effects on the Great Lakes and St. Lawrence River of an increased diversion of 1,000 c.f.s at Chicago. Some of the conclusions of this study are that a temporary diversion (limited to 3 years) would not have too much lasting effect. However, if the additional diversion were permanent, lake levels in Lake Michigan and Lake Huron would be reduced 1 inch, and in Lake Erie and Lake Ontario the lake levels would be reduced five-eighth inch. From a permanent increase, the outflow from these lakes would be reduced 1,000 c.f.s. when the total effect is reached. A plan for regulation of the lake level of Lakes Michigan-Huron could be designed to offset this effect. The cost of this compensatory sill would be $1,530,000 according to the Engineers' study in 1956.

It was estimated that the reduction of flows of the St. Lawrence River due to a 3-year additional diversion would result in maximum lowering of levels of Lake St. Louis and Montreal Harbor of 0.02 and 0.03 feet respectively. On the same basis, lowering due to a permanent diversion would be 0.03 and 0.05 feet respectively.

An increase of 1,000 c.f.s. would not increase depths of the Illinois Waterway, but would increase depths over the lower sills of the locks at Alton, Ill., on the Mississippi River by 0.15 feet during low water periods.

Regarding power loss due to reduced flow, it is estimated that the ultimate annual energy loss at all affected hydroelectric plants from a permanent diversion would be about 303,100,000 kilowatt-hours.

Mr. J. W. Bryce, senior engineer for the Ontario Hydroelectric Power Commission, was quoted in the Windsor Daily Star, April 3, 1959, regarding the power loss resulting from an additional diversion of 1,000 c.f.s. He stated that New York and Ontario would each lose $360,000 annually.

Capacities of the powerplants at Marseilles, Ill., are not such that they could utilize an increase in flow resulting from diversion. Total gain in energy at Lockport would be about 2,700 kilowatt-hours which represents about 8 percent of the ultimate loss at Niagara and St. Lawrence River plants.

With regard to the effect on the shore property of either a temporary or permanent increase in diversion, this would tend to be beneficial during high lake stages, but too small to permit a monetary evaluation of effects.

Navigation too would be affected by an increased diversion. There are today many vessels in the Great Lakes fleet (both United States and Canadian) which are required to load at reduced drafts except at time when the levels of the lakes are high. Consequently, lowering of the lake levels resulting from an increase in diversion will adversely affect Great Lakes navigation. Actual experience shows clearly that vessel operations do take advantage of increments of depth as small as 1 inch. Another factor is that the depth of water in the receiving harbor often determines and limits the maximum loading of the vessel. Many vessels in the present Great Lakes fleet are more than 40 years old and are nearing the end of their economic life. It is reasonable to assume that these vessels will be replaced by deeper and larger vessels.

At various places along the shoreline of the Great Lakes, there are spawning grounds for fish. These would be adversely affected and in some cases completely destroyed by lower lake levels. Migratory waterfowl would also be adversely affected.

Additional lowering of lake levels due to diversion out of the lakes would result in the loss of much recreational land too.

Also, of great concern to the States bordering the Great Lakes is that any additional diversion would set a precedent that could result only in more difficulties due to the lowering of the lakes.

NAVIGATION

The use of a stream for commercial navigation has the following effects upon the other possible uses for which it might be adapted:

Diversion: High levels best.

Public water supply: Slightly unfavorable resulting from impairment of quality by discharge of sewage from boats.

Pollution: Sewage discharge from vessels. Oil pollution from vessels affects waterfowl. Possibility of nuclear waste as a result of nuclear powered vessels.

Recreation, fish, and wildlife: Some wave action from large vessels in narrow channels affects shore property. Turbidity affects spawning grounds. Dredging of channels affects nesting grounds.

Flood control: Negligible.

Power: Negligible.

Drainage: No effects.

Irrigation: No effects.

PUBLIC WATER SUPPLY

Quantity of water withdrawn for public water supply is commonly a small part of the total supply and the manner of its collection, except by impounding, interferes little with downstream flows or qualities. Effects are as shown:

Flood control: Negligible effects.

Pollution: No effects.

Recreation, fish and wildlife: Generally favorable to recreation. Generally favorable, possibly unfavorable to fish and wildlife.

Power: Negligible or slightly unfavorable effects. Streamflow somewhat diminished to extent that supply withdrawn is not returned.

Drainage: Negligible.

Navigation: No effects.

Irrigation: Negligible or slightly unfavorable. Streamflow may be slightly diminished to extent that supply withdrawn is not returned.

Drainage: No effects.

The use of water for public water supply is generally favorable to recreation because impounding reservoirs create recreational facilities such as scenic areas, boating, and bathing. The reservoirs may either provide or destroy natural habitat for fish and wildlife so are favorable or unfavorable as the case may be.

POLLUTION

In respect to competing development for the use or control of surface waters, the effects of pollution may be generalized as shown:

Diversion: No effects.

Navigation: Usually negligible effects, although sludge deposited in channels may require more frequent dredging.

Public water supply: Unfavorable. Bacterial pollution from sewage, unpleasant odor and taste from industrial wastes.

Recreation, fish, and wildlife: Unfavorable as in case of public water supply but of less importance.

Flood control: No effects.

Power: Negligible.

Drainage: No effects.

Irrigation: Negligible, but favorable due to fertilizer values in polluted waters.

As the population of cities located on the Great Lakes and on rivers that empty into the Great Lakes grow, the problem of pollution from untreated sewage and industrial wastes increases. There are conflicts with the com-

munities downstream from the source of the pollution as the polluted water is unsafe for drinking and recreational pursuits are affected.

Sewage usually causes a bacterial pollution, resulting in serious increases in turbidity, color, and suspended and dissolved minerals. Fish, wildlife, and recreation interests can tolerate the use of water for waste disposal up to certain points, depending upon the nature of the waste and the particular interest involved. Raw sewage or treated sewage effluent can be tolerated by fish, aquatic life, and wildlife up to the point that it exceeds the assimilating capacity of the receiving waters and begins to seriously deplete the dissolved oxygen content of the water. Pollution from industrial wastes, especially oils and greases, smothers aquatic life, is injurious to waterfowl, interferes with bathing and spoils the quality of the surface water and beaches.

Three successive States bodies have attacked the problem of pollution. Before 1929, an informal committee dealt with the problem. In August 1929, the stream control commission was organized. It consisted of the conservation director, the health commissioner, agriculture director, highway commissioner, and attorney general. This committee had control over pollution of waters of the State. Their chief weapon was publicity to force industries and cities to install treatment plants.

In 1949, the water resources commission was organized to supplant the stream control commission. The attorney general was dropped from membership and became the law enforcement officer for the State as it was necessary to have a public hearing on pollution before pollution control orders could be issued. The committee was enlarged to include three public members from conservation associations, industrial management, or municipalities. Milton P. Adams is exceutive secretary of the commission, heading a staff of 27.

One of the first court cases involving pollution was started against the Detroit Reduction Co. of French Landing near Belleville. This company collected garbage and dead animals and extracted the valuable grease. The leftover liquor was stored in ponds near the Huron River. There were breaks in the dike and garbage juice was entering the river. In January 1926, an injunction was obtained in Ingham circuit court to compel the company to change operations in 90 days so that pollution of the river ceased. The company was fined $250 for contempt in June 1926.

Grand Rapids was one of the first cities forced to build a sewage system by the State health department. Another disposal plant has been added since the water resources commission obtained decrees in superior court in 1952–53.

The city of Niles was ordered by the Supreme Court in 1941 to stop dumping sewage into the St. Joseph River which flows through Michigan and Indiana. Niles and several cities in Indiana built sewage disposal plants.

The case against Port Huron continued for 13 years before the plant was constructed. The stream control commission ordered Port Huron to abate pollution in 1936. Nothing was done to improve the situation and in December 1939, a suit to enforce the order was started. As time dragged on, wartime shortages caused further delays. The case was reopened in February 1949. The city treasurer was ordered to sign $1,600,000 revenue bonds and the disposal plant was finally built.

Mr. Milton P. Adams tabulated 225 sewage treatment plants now as compared to 20 in 1920. Many towns and cities in Michigan have built plants as a result of court orders, but pollution is still a problem. New users of streams for waste disposal have to show that they will not harm the waters.

Navigation adds, to a small degree, to the pollution picture by the addition of waste disposal and oils from ships. Pollution, in general, has little effect on navigation, although there may be areas where sludge deposited in channels may require more frequent dredging. Recently, Representative Wm. G. Sterling (Democrat, Monroe) asked that a committee be named to study disposal of dredging spoils when rivers, harbors, or channels related to the Great Lakes are deepened. A dredging project was cited which threatens the rights of boaters, fishermen, and hunters, and legislation was suggested to protect them and property owners.

The nuclear age has created a new source of conflict over pollution in the Great Lakes. Nuclear-propelled ships such as the *Savannah*, which will be launched in 1960, emit contaminated water when under fluctuating power, a condition that occurs when entering or leaving a harbor. Danger from radioactive wastes exists also if a collision or other marine casualty occurs. This contaminated water would endanger municipal water supplies.

This hazard was cited at several recent meetings. The Great Lakes section of the Society of Naval Architects and Marine Engineers noted the potential danger. The Great Lakes and Upper Mississippi River Board of Sanitary Engineers passed a resolution urging a prohibition of nuclear-powered ships on the Great Lakes at the present time. Also, the Lake Carriers Association has proposed that the International Safety of Life at Sea Convention adopt a resolution banning the use of nuclear-powered vessels on the Great Lakes.

Pollution is a source of potential international conflict in the Great Lakes-St. Lawerence Basin. Waste disposal at locations where injury could reach the neighboring country's border calls for careful control and attention by the governments of both countries and their States and Provinces. Recently, Mackinac Island was accused of emptying raw sewage into the waters of the straits. Other areas within the Michigan scene which are sources of potential conflict are the St. Marys, St. Clair, and Detroit Rivers.

The International Joint Commission has adopted standards which would eliminate problems of municipal and industrial pollution. In the treaty of 1909, the United States and Canada agreed not to harm each other's waters.

RECREATION, FISH, AND WILDLIFE

Ordinarily no water is withdrawn or consumed for recreation, fish, and wildlife uses and there is little effect upon water quality. Effects are as shown:

Diversion: No effects.

Navigation: No effects.

Public water supply: Usually no effects, except for bathing in the immediate vinicity of the intake, which is unfavorable.

Pollution: No effects.

Flood control: No effects.

Power: No effects.

Drainage: No effects.

Irrigation: No effects.

The majority of Michigan's water conflicts between the fish-wildlife-recreation interests and other water developments are on inland lakes and streams rather than on the Great Lakes.

Some streams in the basin, particularly trout water, could be adversely affected by power-dam construction. Some forms of wildlife such as deer and upland game may be harmed while waterfowl and aquatic furbearers may be benefited. However, most large hydropower developments are run-of-the-river dams. They only serve to create a "head" and not to impound enough water to carry them through the dry season. Rather than lowering the water level to make use of what little water has been stored, they curtail their power development and keep the water level up to maintain the "head."

Several years ago, one conflict was the interference of power dams with fish migration and navigation on streams. With the decline in dependence upon water power for the generation of electricity, this problem is no longer too important in Michigan.

In Wisconsin, the Brule River has been proposed as the site for several dams and even a navigation project. The State of Wisconsin passed a law prohibiting further dam construction on this stream. The Brule is one of Wisconsin's best trout streams. There are numerous Canadian streams where power dams have been considered which would adversely affect valuable trout fisheries.

In Michigan, there are practically no instances where conflicts eixst over locating dams in areas considered valuable in their natural state. All dams do not affect fish and wildlife adversely. In many cases important fisheries have been created by construction of dams. Frequently the construction of a dam may create an impoundment which is valuable for recreation and which affords excellent fishing and wildlife habitat. There is a decrease in the number of dams being constructed in Michigan.

Conflicts between recreation and other water uses in the operation of storage reservoirs depend on the operation of the specific reservoir involved and the species of game and fish involved. The problem is rather unimportant because there are not many reservoir locations in Michigan suitable for water storage on a large scale. If many such reservoirs were to be constructed, there undoubtedly would be some conflict of interest because storage, for whatever reason, requires a fluctuating level, whereas a more stable level is usually best for recreation and for fish life.

A major conflict at present is the filling along shorelines of both the Great Lakes and inland lakes for the purpose of real estate development. Such projects frequently eliminate desirable fish spawning areas and wildlife habitat. Furthermore, this is illegal. On the Great Lakes, the submerged lands are held in trust for the public and on inland lakes our Supreme Court has held that no riparian owner has the right to decrease the surface area of the lake.

Too, shorelines are being used in increasing amounts for docks instead of fishing areas and the same use is being made of many marshes, decreasing waterfowl areas.

Lake-frontage owners prefer to have the lake levels at moderate or low stages in order to avoid erosion and maintain wide beaches. In contrast, the navigation interests usually prefer high levels which permit the fullest possible loading of large vessels. These contrasting desires could cause a problem if attempts were made to control Great Lakes levels so as to produce conditions different from those which would occur without the control.

The proposed navigation project known as the Inland Route in the tip of the Lower Peninsula of Michigan could adversely affect the fishing in several lakes and rivers. The opening of the St. Lawrence Seaway and the resulting increased traffic may have an effect on biological productivity due to changes in the turbidity of the waters; however, the overall effect on fish and wildlife is not considered extremely significant.

Especially in recent years, the State fish and game departments and the Fish and Wildlife Service have been forced to look on while private dredging operators have chewed up the bottoms of bays and estuaries under permits from the Corps of Engineers. These permits were specifically and publicly represented to take into account the effects on navigation only. Dredging and spoil disposal could be injurious to fish spawning habitat and to waterfowl feeding areas.

There is a growing conflict between the use of high-powered speedboats and the interests of wildlife, fishermen, and bathers on many of our inland lakes. The same type of conflict in less degree is that of canoes versus fishermen on some of our important trout streams.

The Chicago water diversion is definitely a conflict between the municipal needs of Chicago and the recreation, navigation, and waterpower interests of the Great Lakes States and Canada.

Thousands of people in the United States and Canada depend entirely upon the fish crop they harvest for a livelihood. As of recent years, the Great Lakes have produced in an average year about 105 million pounds of fishery products. The establishment of a population of parasitic sea lamprey has destroyed seven-eighths of the Mackinac trout that swam in the Great Lakes. The campaign to eliminate the lamprey is now underway. Four to six generations of lamprey larvae already hatched and living out their larval existence in the streambeds are being killed by chemical means. Next on the list is Lake Huron, and after that, Lake Michigan. It is estimated that the entire program for the three lakes will require 5 years (hoped, that is).

A vast program of restocking the Great Lakes has already started. The program will be stepped up and maintained for 10 years. By then scientists hope that the trout will be able by natural reproduction to reestablish themselves in the inland seas. To support the planting program, a new Federal lake-trout hatchery will be built in Michigan, and the capacity of present hatcheries will be expanded. Since the new Great Lakes trout should find no shortage of food, there is a bright outlook for the future of Mackinac trout.

With the local lamprey population under control, a conflict of fish versus navigation could exist if sea lamprey hitchhike on the bottom of ocean vessels entering the St. Lawrence Seaway. This would be a minor problem, since lamprey will be controlled by treating all spawning streams on a rotation basis—about once every 4 years.

The use of water for irrigation is rapidly developing into a source of conflict. Irrigation is a consumptive use of water. Water abstracted from lakes or streams is almost entirely used by the crops being irrigated and is not returned to the underground or surface waters. Irrigation is rapidly increasing and because it is most generally applied during summer months when streamflow and lake levels are naturally low, it is detrimental to fish-wildlife-recreation uses of water. Agricultural drainage is causing a severe loss of valuable acreage for waterfowl breeding habitat. Conflicts between farmers and cottage owners, bathers, boat enthusiasts and fish and wildlife interests are destined to become more widespread.

Conflicts exist between water pollution and the fish-wildlife-recreation interests. As the population of towns and cities increase, the problem of pollution from untreated sewage and industrial wastes increases. The quality of the fine sand beaches around the Great Lakes and the enjoyment of sport fishing, industrial fishing, and recreational pursuits can be affected. Pollution from industrial wastes, especially oil, affects waterfowl hunting, smothers aquatic life and renders water surfaces and beaches unattractive.

Generally, industrial and domestic usage, waste carrying and most water uses are adverse to the best fish-wildlife-recreation conditions. An increasing need for water for these purposes will result in a decreased flow for fish-wildlife-recreation usage. This condition is growing rather than declining. We may find in the future that water for recreational purposes will have to give way to water needs of higher priority.

The New Fish and Wildlife Coordination Act of 1958 (Public Law 85–624) is a noteworthy amendment to Public Law 732. Secretary of the Interior Fred A. Seaton feels it is the most important conservation legislation in a quarter of a century.

The new act states in part that "* * * Wildlife conservation shall receive equal consideration and be coordinated with other features of water resource development programs * * *." In addition to new programs, the act applies to some 800 active previously authorized projects in the backlog of the Corps of Eingineers and the Bureau of Reclamation.

Although this new legislation authorizes fish and wildlife conservation and is a much improved act to accomplish the conservation job, it does not give the Fish and Wildlife Service or State fish and game agencies veto power over any part of the Federal water resources program nor does it require adoption (by the Federal construction agencies) of the conservation recommendations of the Fish and Wildlife Service and the State fish and game departments. Logic, reason, and technical soundness must combine to bring about the desired results for fish and wildlife conservation.

FLOOD CONTROL

The effect upon various uses of stream depends upon type of control adopted. If control affected by any of four methods usually used (negligible when control is by storage) effects are as shown:

Diversion: Little change.

Navigation: Usually slightly favorable.

Public water supply: Reservoirs allow sedimentation. Slightly favorable to quality.

Pollution: Favorable. Increases period of high flow, hence length of dilution period.

Recreation, fish, and wildlife: Negligible effects for recreation. Slightly unfavorable for wildlife due to destruction of natural habitat.

Power: Favorable or unfavorable. Flood control reduces peak flow and prolongs periods of high flow.

Drainage: Negligible.

Irrigation: Negligible.

Michigan floods are of two types. Most common is the flooding of river basins due to heavy precipitation. The second kind is inundation of low-lying areas along the shores and tributaries of the Great Lakes due chiefly to high lake levels.

Few river basin floods are dangerous or widespread. One reason is that no part of Michigan is very far from one of the Great Lakes which can absorb vast quantities of water with little change in its water level. Also, Michigan does not seem to have storms as large as those found, for example, in Ohio.

However, there is some reason to believe that danger from such floods may be increasing, especially in the more populated areas, due to the increasing pressure on the river valleys. These valleys serve as safety valves, areas which can hold excess water safely. Greedy or thoughtless owners fill in valleys to provide eventual building sites or to get rid of trash. Also, the rivers have been allowed to become choked with debris so that they run more slowly. More roads are built across the valleys, each one largely earthfilled with a bridge span over the stream itself, and each one therefore acting as a dam in time of floods. More people are tempted to build on valley land and may do so unless there is a local governmental authority with enough wisdom and power to forbid them. Further, the amount of runoff water increases as the land is built up. Ground in fields is porous and able to absorb rainwater. Covered with streets and buildings,

it can no longer absorb rain which then joins the runoff. All these factors cut down on the value of valleys in flood control.

Very few flood control projects have yet been developed in Michigan. Because our topography is not generally suitable for floodwater detention in reservoirs, improvements to date have been and future improvements undoubtedly will be devoted to the alleviation of local flood conditioned by channel deepening and widening. To a limited extent this practice may tend to aggravate downstream flood problems by speeding the water on its way. Generally however, this aggravation is so very slight as to have no significance. A unique problem that has developed in Michigan flood control projects is the lowering of local groundwater levels in the nonflood season by channel deepening. This tends somewhat to reduce the yield of nearby wells. Under some circumstances, damming the water up during low-flow periods would counteract the results of deepening. But where the stream is used for waste disposal as is true of most southern Michigan rivers, pooling the water reduces its waste assimilating capacity, and may so aggravate pollution conditions as to be unfeasible.

While there is at least one instance of a river wall being built, these are not common and create drainage problems in normal times in the land behind the wall.

As a measure of prevention against floods becoming more serious, it has been suggested that river valleys be protected against being filled. Possibly this could be done by forbidding filling without permission of an agency such as the water resources commission.

New flood control measures in Michigan date before 1947. In most all cases, planning and construction have been done by the Army Corps of Engineers which has authority to act in headwaters of navigable streams. However, projects are initiated locally and financing is joint Federal and local.

The procedure in such flood control projects is as follows: Interested individuals and groups approach their Congressmen or Senators who prevail upon the House or Senate Committee on Public Works to authorize the Army Engineers to make a study. The study, which begins with a public hearing, is then made and recommendation as to needed improvements drawn up. The Federal Fish and Wildlife Service, and through it, the State department of conservation, as well as the State water resources commission are always consulted. If an area of conflict is found—for example, if straightening a river would destroy the nesting grounds of a great many ducks—changes would probably be made to preserve these nesting grounds or create new ones. An important part of the study is computing the costs of a project and the value of benefits to be derived from it. A project, in order to be recommended, must have a sufficiently high ratio of benefits to costs.

When the study has been made and accepted by the Chief of Army Engineers, it is returned to Congress, which must (1) authorize the project, and (2) appropriate necessary funds. After both these steps are taken, the contracts can be let and construction begun.

The work will not be done unless there is participation by the local communities. The local share of costs is figured by determining what proportion purely local benefits are of the total. Usually this has been about 50 percent. Also, there must be just one governmental body or authority with which the Army Engineers must deal. Local communities must furnish the land for the project, usually by condemnation, but sometimes by creating easements on privately owned land. The local governments must also assume responsibility for maintenance of the project, when completed, with Army Engineers' supervision. A local flood control project in the Flint area has recently caused the lowering of a lake through which the river flows and will necessitate construction of a water level control dam to meet the needs of cottagers and other recreational interests around the lake. Control of floods in the Portage Lake area of Livingston-Washtenaw Counties, when and if it materializes, will also require some expenditures for lake level control during nonflood periods.

A recent proposal to locate a dam on a tributary of the Kalamazoo River to store water for release during low flow periods for pollution purposes was very strenuously opposed by the owners of land who would be flooded out by the project as well as by other local interests who considered the land more useful in its natural state than as a storage reservoir. The reservoir project was abandoned as being economically unfeasible at the present time. However, since the use of such reservoirs constitutes the only possibility for significantly increasing the droughttime flow of streams this conflict remains incipient and

may become serious as industry reaches the limits of waste treatment possibilities and turns to low flow improvement methods. Careful coordination among all the interests involved and good educational programs well in advance of reservoir development may tend to minimize this type of conflict. It is expected, however, that people will always resist being forced out of their homes and away from their farms or other lands used by reservoir projects.

As of summer 1959, three projects have been completed: Two on the Clinton River and one on the Sebewaing. Under construction is one project on the Kalamazoo at Battle Creek. Three others have been authorized, but no money appropriated. These are on the Saginaw, the Grand at Lansing, and the Kalamazoo at Kalamazoo. Studies are being made of the Rouge, the Au Gres, the Kawkawlin, the Huron, the Grand at Grand Rapids, the St. Joseph, and a third Clinton River project.

Dams for flood control have not seemed practical in Michigan. There has been some interest in dams for saving excess water for summer use, but these dams cannot serve for flood control, too. A dam to release water to streams in summer has to have water behind it; a dam for flood control should have little or no water behind it.

Flood control projects for certain shoreline areas were recommended as both feasible and economically justified by the Chief of Army Engineers in 1952. The recommendation has not been acted upon by Congress since that body has not yet clarified the intent of flood control legislation as to inundation of property because of wind, waves, or tidal effect on the Great Lakes. Areas specified were Lakewood-Luna Pier and Detroit Beach in Michigan and Point Place at Toledo, Ohio. The projects would be mainly of the dike type.

Generally flood control in Michigan can be handled so as not to conflict seriously with other water developments. Care is required, however, so that proper cognizance is taken of the other water interests and their needs can be accommodated in the project.

WATER POWER

Developments have the following effects upon the use of a stream for other purposes:

Diversion: None.

Navigation: Favorable above dam. Either favorable or unfavorable below dam.

Public water supply: Favorable or unfavorable both as to quantity and quality.

Pollution: Generally unfavorable to upstream uses. Reservoirs do not provide purifying action of flowing water.

Recreation, fish, and wildlife: Generally favorable to recreation. Generally unfavorable to wildlife.

Flood control: Favorable usually only to a small degree reduces peak flow by storage.

Drainage: Negligible.

Irrigation: Negligible.

Hydroelectric and fuel development complement each other in Michigan rather than conflict. The larger power companies make use of hydropower to meet peak demands and their steam to carry the steady load. Possibly some of the very smallest power companies depend entirely on hydropower but there would be no conflict between that use and the use of coal or oil.

The electric power generating plants of the Detroit Edison Co. are located along the St. Clair and Detroit Rivers. They cannot be classed as water users. They may be said to be water borrowers. The vast quantities which they use are for cooling purposes only—temperatures are raised a degree or two, trash and other material screened out—water treated with chlorine and discharged back into the stream. The water is returned in better condition than when it was received.

There is always somewhat of a conflict between dams built for flood control purposes and hydroelectric power generation to the degree that power generation requires a full reservoir and flood control would require a low reservoir in advance of extreme water flow conditions.

Diversions from streams upstream from hydro powerplants during ordinary irrigation season consumes water that would otherwise be used for power development. Theoretically therefore, it may be said that there is a basis for conflict between these two uses. The irrigation diversion from streams on which major power developments are located has not as yet become great enough

to cause any open disputes. However, one of the power companies in the Northern Peninsula went on record at a legislative committee hearing last summer favoring financial reimbursement for such diversion which would impair the power producing capacity of a stream. If the irrigation usage continues to grow it may well reach proportions requiring determination of the power companies' rights and provision for compensation for improvement of those rights.

There are in some areas conflicts with wildlife uses. Dams prevent free migration of fish. Reservoirs destroy natural habitat of wildlife and if levels fluctuate widely, fish spawn are destroyed. On the other hand, if levels are maintained fairly constant, effects may be favorable. Recreational uses are generally favored. Reservoirs provide additional facilities for bathing, fishing, and boating.

There can be conflicts over locating dams in areas considered valuable in their natural state because of the area inundated by the reservoir formed. However, there is no indication at the present that additional hydorelectric dams will be constructed in Michigan. Regulation of water supply for power may increase or decrease low water flow. Reservoirs may provide sedimentation or may impart objectionable tastes due to vegetable growth to any water for domestic use.

The question of tax losses in local areas can be best answered in regard to potential development in the future. It is possible that the department of health and water resource commission will refuse building permits for sewage treatment plants whose effluent will discharge into streams whose flow is inadequate to carry effluent. If sewage treatment plants cannot be enlarged, residential, commercial, and industrial building will also be prohibited, therefore, the tax base cannot be altered. Huron Valley has this problem.

Depending upon the agency building dams, there could be substantial tax losses to local areas as a result of such construction. For instance, property inundated as a result of the construction of Tennessee Valley Authority dams is removed from the tax roll since that agency does not pay property tax.

DRAINAGE

In respect to competing developments for the use and control of waters, the effects of drainage may be generalized as shown:

Diversion: None.

Navigation: Negligible.

Public water supply: Favorable or unfavorable either in small degree, usually negligible.

Pollution: No effects.

Recreation, fish, and wildlife: Favorable or unfavorable for recreation. Unfavorable for wildlife.

Flood control: Unfavorable. Tends to increase flood flows.

Power: Favorable or unfavorable usually to small extent.

Irrigation: Incompatible in close proximity.

Rivers form, in every country, the natural system of arterial drainage but it is often necessary to supplement them by artificial means to prevent land in low-lying districts from becoming waterlogged. Underdrainage is effected by systems of parallel clay tile drains laid at a customary depth of 2½ to 4 feet and spaced 60 to 150 feet apart. The present practice is to use 4- or 5-inch tiles for these laterals. Surface drainage is usually effected by ploughing the land into convex ridges off which water runs into intervening furrows and is conveyed into ditches. Drainage districts range in size from small tile districts of a few hundred acres to large outlet districts of 500,000 acres.

In setting about the draining of a field, the first point is to secure proper outfall. The lines of the receiving must next be determined then the direction of the parallel drains. The former must occupy the lowest part of natural hollows and the latter must run in the line of the greatest slope.

The presence of stagnant water in the soil is a source of many evils. Wet pasture produces only coarser grasses, with little or no value for feeding. The animals grazed upon it are unduly liable to disease. Tillage operations on such lands are often interrupted by rain and harvest of crops very difficult. The roots of plants require both air and warmth. A deep stratum through which water can percolate but in which it cannot stagnate is necessary. The surface of the water in the supersaturated soil is known as water table and is exemplified in water standing in a well. Water will rise in clay by capillarity to a height of 50 inches, in sand 22 inches. Drainage reduced the surface tension

of the capillary water by removal of excess, but the natural water table may be many feet below.

Resource management, especially that of soil and water, is complex because of the great and profound interrelationship among resources and even within a single resource. This complexity leads to difficulty and danger in generalizing about the effects of various water and land management practices. If we are to be correct in appraising those effects, we must always finish the sentence by specifying under what conditions the effect may be expected and to what degree.

Consider for example, the statement that artificial drainage lowers ground water levels. As far as it goes, the sentence is perfectly correct—that is the primary purpose of drainage but it can lower them only to the flow line of the drain and only in the immediate area. Thus the need for auxiliary tile fields to gird the lands which it is desired to drain. If a drain cuts deeply into very porous gravel—its effects will extend much farther—sometimes affecting nearby lakes. Appropriate drainage improves certain lakes and stream conditions, thus making resort development practicable. Drainage may and can depreciate recreational values by lowering lake levels. Wildlife habitat may be destroyed by drainage.

Since drainage lowers water levels, it reduces the total quantity of water in the drainage basin under what it was before drainage. It is not safe to assume that the available water supply is diminished. If levels are drawn down enough to take them below water loving plants such as cattails and willows, more underground water is left to sustain the low flow of streams. Drainage of swamps and marshes where water stands above ground most of the time may improve the qualities of water. Lowering of ground water table may reduce average quantity available in streams or underground sources. The fact that a marsh, swamp, or lake fails to supply outflow water during drought and that its water surface even lowers at that time does not show it is a ground water outlet area nor indicate that its water is seeping into the ground. It may mean that losses through direct evaporation and through vegetation are greater than quantity of ground and surface water flowing into them.

Wells depend upon ground water and are generally finished considerable below the water table. Shallow wells 25 to 30 feet deep are hard to protect from contamination and water is warmer and less palatable. In drilling wells, gravel is sought more than water. High capacity wells produce a cone-shaped down draw which tends to relieve pressure on deep formations so their water control percolates up. A drain produces a miniature down draw and similarly relieves pressure in underlying formations. Drainage tends to increase flood and storm flow and for dry weather flows to be decreased. Channel deepening tends to aid disposal of floodwater much more than low flows. These matters are readily susceptible of engineering analysis, just as are downstream requirements for adequate outlets.

The flood and storm flows increase and dry weather flows decrease with corresponding effects on power production. Interest in irrigation is increasing. In this there is the physical problem of getting water where and when it is needed, because reservoir sites in Michigan are scarce, and a legal problem of envolved water rights.

The drainage laws have become so lengthy and complex that it is difficult for a layman to understand. Drainage is entirely outside the field of the water resources commission except as one or two sections of drain law involve it in pollution control.

Of all water uses and controls, land drainage probably has the most widespread and least realized influence upon other water uses and controls. Ill-advised drainage may, and actually has in some cases in Michigan, wrought irreparable damage by lowering of the ground water table. However, drainage is necessary for agricultural developments in some areas.

IRRIGATION

Unless the water supply is obtained from stored floodwaters, the effects of this practice of irrigation upon the use of a stream for other purposes are as follows:

Diversion: None.

Navigation: Unfavorable. Reduces navigable depth.

Public water supply: Unfavorable. Reduces supply available.

Pollution: Unfavorable. Reduces flow and ability to provide proper dilution.

Recreation, fish and wildlife: Usually unfavorable. Reduces low flow. Reservoirs prevent free migration of fish and reservoir levels necessarily fluctuate greatly, destroying fish spawn.

Flood control: Favorable. Reduces floodflow.

Power: Unfavorable as it reduces flow available.

Drainage: Incompatible.

Irrigation as a major use of water is comparatively recent in Michigan. Our average precipitation on about 31 inches a year has made it possible to grow crops without irrigating them. But Michigan farmers have now discovered that supplemental irrigation can do a great deal for them. Among other things, it can increase quality as well as quantity of crops. Irrigation has proved profitable even though expensive.

Farmers are not the only users of irrigation. A great deal of irrigation is in use on golf courses, parks, and cemeteries.

The water is taken from streams, drains, lakes, or from wells, depending on local conditions. Some farmers simply scoop out a pit in swampland and depend on seepage to maintain a supply.

Because of its consuming nature, irrigation is competing against all other uses of water. The potential effect on natural streamflow, should the practice become general or even substantial in any given area, leads to concern over effects on other water uses. State, interstate, and Federal water pollution control agencies are particularly concerned with possible effects on water pollution control programs. These effects could extend beyond State boundaries and become of interstate and regional interest.

Irrigation has been increasing in Michigan at the rate of about 10 percent a year. At present, about 68,000 acres are irrigated, but compared to the approximately 18 million acres in agricultural production, it is still quite small. Michigan holds to the riparian doctrine of water rights. This states that only those persons owning property adjacent to or over water have a right to its use. Further, users are permitted only a "reasonable" use of the water and must return it essentially unchanged to the stream for the benefit of downstream users. No water rights legislation has yet been passed by the legislature.

Conflicts in demand for the total water use have not been sufficient to bring about comprehensive development of principles for allocation of water or establishment of State agencies to administer them.

Courts have held that use of diversion of water from streams for any purpose is permissible up to the point at which a downstream user is injured. The latter must then bring suit to protect his rights.

Irrigation water needs coincide with the seasonal period of shortest surface water supply (low streamflow and lake levels) and highest usage for other purposes. Recreation is in full swing, making fullest possible use of beaches and water areas for bathing, boating, and fishing.

Hydroelectric and some steam powerplants use every gallon of water during normal and low flow. Any upstream diversions for irrigation constitute subtractions from the power development potential.

Municipal water needs are highest during the irrigation season. Fortunately, not too many Michigan cities depend on inland lakes and streams for supply, but some increase in their numbers is to be expected as local ground water sources become inadequate to meet population increases.

On a lesser scale, creek and brook flow, essential for cattle watering and other domestic uses, is highly vulnerable to irrigation withdrawals.

Spawning grounds for fish can be destroyed due to low flow in streams. This could also adversely affect migratory waterfowl.

Navigable streams that have lower levels due to irrigation could be affected a great deal.

Excess water could be stored in the spring in farm ponds and used for irrigation in the summer, although it is doubtful if this method could meet all irrigation demands. The construction of reservoirs would be expensive, and there is a question as to how many sites are available because of Michigan's flat terrain. Sites in the more heavily populated areas, where they are most needed, would undoubtedly be in conflict with use of recreation and highways.

Sooner or later there will be comprehensive legislation for control of water due to the competitive uses. This control will result from either advanced thinking and planned legislation or from necessity based on court action brought about by developing conflicts. This legislation will be hard to write. Streams differ greatly in their capacity to sustain different uses and the same stream will vary

in this regard from season to season and year to year. Probably such a law would leave considerable discretion in the hands of the administrative body. Of course, no law can increase the amount of water available, but only decide which uses have priority.

CONCLUSION

As has been shown in the preceding material, there is not a single use that can be made of our water resources that does not affect in some way or another at least one (and often more) of the possible uses that can be made of those resources. With a steadily growing population and a constantly increasing utilization of our water resources, these conflicts of use multiply. Such conflicts of use and control as arise must be resolved, not by the application of some general formula, but by the exercise of good judgment based upon careful analysis of facts.

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NATIONAL ITEMS IN SECOND YEAR

WATER STUDY

(By Edna Greig, member, State committee on water resources)

November is target date for consensus on national item II. Leagues will attempt to spell out the types of legislation and administrative procedures which they believe will implement the league's objectives in national water resources development in the areas of coordinated administration, equitable financing, and regional or river-basin planning. (The National Voters of January, March, April, and May 1959 provide important background material.)

To league members in Michigan the conflict and overlapping between Federal agencies has been less vivid than to members in Western States and has required homework rather than field work for understanding. Michigan's terrains and rivers are not adapted to large multipurpose projects, nor does its agriculture depend greatly upon irrigation. Hence, we do not find the Bureau of Reclamation, the Department of Agriculture, and the Corps of Engineers constructing multipurpose dams, with varying standards for justifying such projects, varying requirements for repayment from those who benefit, and the attendant political pressures. Yet we have come to recognize the need for reasonably uniform standards of evaluation and repayment.

The largest Federal water projects in Michigan are commercial navigation improvements, historically a Corps of Engineers function and financed on all the country's navigable streams with Federal funds.

The cost of such improvements in Michigan, calculated to June 30, 1956, was $125,496,002 plus $66,602,788 for maintenance.

Flood control works are relatively small, when compared with those on rivers like the Ohio, Missouri, and Mississippi, and do not require multipurpose reservoirs but consist, rather, of channel works, traditionally a corps activity.

Michigan ranks 37th among the States in funds received for flood control during the last 21 years. Since flood control entails some repayment, the question of equitable cost-sharing has arisen. Under existing practice the cost to non-Federal interests may vary from 1.3 to 63 percent. Recognizing the inequity of this, the Uniform Cost-Sharing Act for Flood Control, introduced in the last Congress, sought to provide for uniform cost-sharing standards for all Federal agencies and fixed the cost to non-Federal interests at not less than 30 percent.

Through December 1958, corps flood control projects in Michigan cost $2,531,453. Underway at that time was the Kalamazoo River project for which the estimated Federal contribution is $5,453,000 and the local, $2,938,000.

In Michigan, the State has taken leadership in watershed treatment, an activity associated with multipurpose projects where they exist. State watershed projects involve relatively unspectacular activities, like sodding of waterways, tree planting, planned changes in land use, and small-scale channel works, but this does not diminish the importance or success of these projects, the first of which was completed on the Rifle River in 1954. This pilot project was directed by the Michigan Department of Conservation which secured the cooperation of other State, Federal, and local agencies in rehabilitation of a small watershed.

The stated objective was improvement in fishing, and funds came from fishing license money, Dingell-Johnson Federal funds and to a lesser degree from the U.S. Agricultural Conservation program. The project not only improved fishing but also stabilized streamflow, improved farmland management, road drainage, and development of State-owned and wildlands.

Ten additional watershed projects have since been undertaken and a statewide survey of watersheds is now in progress. Michigan's experience in these projects may emphasize the importance and effectiveness of planning and development tied closely to the area involved.

The best nationwide example of effective Federal-State participation and equitable financing is found in the sewage treatment program financed through Federal grants-in-aid under the Water Pollution Control Act. These grants are administered in Michigan by the water resources commission and 30 treatment plants have been financed under the act. This act may well serve as a pattern in other areas of water resources development, as it leaves initiative to the States and insures reasonably uniform standards of cost sharing.

There have been many proposals for improved coordination and planning at the regional or river-basin level. Throughout the country leagues have been finding that coordination is actually proceding rapidly at these levels but there is a recognized need for suitable machinery to provide for orderly and effective coordination among all levels of government. Existing river-basin or interagency commissions have limited objectives and are unable to initiate planning and coordination at a sufficiently early stage. (The Great Lakes Basin compact, still lacking congressional approval, provides for a consultative and recommendatory agency.) Legislation was introduced in the last Congress (H.R. 3704) to authorize the President to create river basin commissions to serve as principal agencies for coordinating planning. Another proposal, S. 1591, would have established the river basin as the basis for multipurpose development. Further proposals, which the league may wish to consider, will undoubtedly come from the work of the Senate interim select committee, which will hold regional hearings this fall on water resources development needed between now and 1980 in order to supply water-use requirements of population, agriculture, and industry.

Senator HART. Incidentally, any family that has children who have any flair for local geography would benefit from obtaining from the league these "Know Your River Basin" documents. I have broadened my very limited knowledge of river basins from the Dakotas east as a result of this.

Russell G. Hill, the State conservation committee.

STATEMENT OF RUSSELL G. HILL, MICHIGAN STATE SOIL CONSERVATION COMMITTEE

Mr. HILL. Thank you, Senator Hart.

We have submitted a complete report which I hope will be added to the record of your hearings.

Senator HART. It will be.

(The information referred to follows:)

STATEMENT OF RUSSELL G. HILL, EXECUTIVE SECRETARY, MICHIGAN STATE SOIL CONSERVATION COMMITTEE

The interest of the Michigan State Soil Conservation Committee in water resources is defined in the declaration of policy prefacing the Soil Conservation District Act of 1937 which established the committee. "It is hereby declared to be the policy of the legislature to provide for the conservation of the soil and soil resources of this State, and for the control and prevention of soil erosion, and thereby to preserve natural resources, control floods, prevent impairment of dams and reservoirs, assist in maintaining the navigability of rivers and harbors, preserve wildlife, protect the tax base, protect public lands and protect and promote the health, safety, and general welfare of the people of this State."

The State soil conservation committee is cognizant of the increasing demands for the water supplies of this State. Regardless of its adequate rainfall, abundant ground water and favorable position in respect to the Great Lakes, the future water needs of Michigan will not be met unless significant water development measures are undertaken. Specifically there will be tremendous increases in the demands for quality water for domestic use, agriculture, industry and recreation. Competition for limited water supplies in some areas is now acute. Consumptive water uses are developing. The fact that industry is rapidly expanding and population is increasing will increase the critical nature of the water resource situation.

It is the opinion of the State soil conservation committee that the necessary water resource activities and remedial actions to insure future supplies is a primary function of State and local government assisted by nongovernmental and governmental agencies. The authority of the State to control, appropriate, use or distribute water is coupled with the right to make such legislative improvements as are needed.

The acute nature of the water resource problem calls for a course of action with at least three phases that can and must be conducted concurrently. Specific recommendations for each phase follow:

A. POLICY-INVENTORY-RESEARCH AND INFORMATION

1. Both a National and a State water policy must be formulated that will lead to the development of the resource for the maximum benefit for all people.

2. Appropriate State agencies must exert leadership in obtaining an inventory of the State's water resources. Federal assistance in addition to that furnished by the U.S. Geological Survey could help facilitate such an inventory.

3. Basic water resource data must be obtained, analyzed and printed for distribution. Basic research on our water resource is unjustly weak and underfinanced.

4. States should stimulate water development measures on the part of regional and local interests. This in conjunction with a program of education and dissemination of information.

B. LEGISLATIVE

New legislation, supporting and conforming to the State's water policy will be necessary. It must deal with drainage, water use rights, water control, water pollution, etc. Specifically, legislation to minimize water competitive use conflicts is urgently needed. Present State legislation permitting the organization of water management districts must be modified.

C. WATER RESOURCE ACTION PROGRAMS

Pending the initiation and development of policy, inventory, research and legislative measures, the presently operating local, State, and Federal action programs must be encouraged and extended by financial support. These action programs are currently aimed at water resource development and are making a significant contribution. Specifically in Michigan these programs are listed as follows:

1. Soil conservation districts: Soil conservation must be a supplement to water management programs. There are 76 soil conservation districts operating in Michigan. 33,000 Michigan farms are district cooperators. Many of these cooperators also take advantage of the USDA conservation cost-sharing program. Land-use practices, promoted by districts, are an effective part of water development and control. It is estimated that 98 percent of total precipitation falls on land surfaces. It either runs off overland, or enters the ground, depending upon the type of rainfall, condition of the soil, and its vegetative cover. Water control and development programs must originate therefore, with those in control of the land. Currently the programs of soil conservation districts deal with—

(*a*) Land treatment practices including contouring, fertility improvement, reforestation, strip cropping, vegetative cover, etc., that control erosion, reduce water runoff and prevent siltation of ditches, streams and reservoirs. A fertile topsoil protected from erosion will hold an estimated 3 inches of water in its top 7 inches. Topsoil may hold as much as five times as much water as the same area of subsoil.

(*b*) Agricultural drainage practices that meet our modern land and water use requirements.

(*c*) Construction of ponds, dams, impoundments, etc., that contribute to flood control, storage of excess water and reduction of pollution by silt. Such structures are an integral part of our irrigation development and are useful as well as a source of water for farm safety, recreation, spraying, etc. Erosion control must be carried out in the watershed above such structures to reduce sedimentation.

(*d*) Cosponsorship of small watershed projects. Entry of soil conservation districts in the area of waterhed development is based on the premise that land and water problems are also watershed problems and can best be solved under local initiative and direction.

The programs of soil conservation districts are developed and operated locally by landowners. Cooperators of the district are in control of the water resource that will play an important role in future water developments.

Additional assistance from the U.S. Soil Conservation Service for technical help to soil conservation districts has not kept pace with the need. In many areas there is also considerable need for additional foresters.

2. Small watershed programs: Michigan now has 6 approved watershed projects under congressional act 566. Preliminary work that will lead to 3 additional watershed projects is now underway. There are at least 10 department of conservation watershed projects on a stream improvement basis operating in Michigan. There are about 20 other small watershed projects involving small groups of farmers and utilizing pooling agreements under the USDA agriculture conservation program. There is growing evidence that the watershed approach may be the most efficient and practical method of solving surface water resource problems. Federal assistance to local watershed groups should be continued and expanded. In principle the cost sharing of assistance with watershed projects appears sound. We have not had enough experience with watershed construction in Michigan to date to evaluate current cost-sharing policies. Better coordination of watershed responsibilities vested in various agencies at the Federal level is desirable to increase efficiency of aid to local units.

3. River basin projects such as the Saginaw Valley, Grand River and others which have been approved but no funds have been appropriated by Congress to initiate construction.

4. Zoning regulations must be strengthened to restrict hazardous use of flood plains and to protect channels from being narrowed to a point where they contribute to flooding.

5. Pollution control must be continually supported and expanded to provide clean water for multiple use and for reuse. The reuse of water through purification offers a significant opportunity for increased water management.

6. Pipelines: Planning must be continued to provide adequate legislative authority and financing methods to pipe Great Lakes water to inland communities.

The ultimate success of water resource activities will be dependent upon the extent to which apathy of local people can be overcome. Educational and informational efforts to acquaint all people with water resource management must be greatly accelerated. It represents a limiting factor to more efficient water use. Opportunities must be provided for these people to organize on a local watershed basis with authority to plan, finance, construct, operate and administer the structures and other measures that will help solve water resource problems.

Mr. HILL. Therefore, I will just highlight some of the information which we have in the complete report.

I think one point that stands out in the hearings to date is the fact that people seem to represent the basis of much of our problems. We recognize of course in this State that our population is increasing as fast if not faster than most other States in the entire Union. We not only have this increase in population but we have a shift not only in the residence of our people but in the location of our industry. This shift is spreadying out to include the southern third of the State. Along with this spread of people and in their living habits and the spread of industry comes the fact that this same area, the southern third of Michigan, is the location of the largest quantity and the best quality of our agricultural land.

No one method to control the water problem can be utilized. As we consider multiple use of water we must also consider the multiple efforts to correct this water problem.

We on the State soil conservation committee support much of what has already been said by other Michigan representatives. We have specific reference to the need for considerable additional research, not

only in the question of water in industry, water for recreation, but likewise water use in agriculture.

The transpiration-evaporation problems which we have, the water runoff in terms of land-use practices, infiltration and its relationship to agricultural methods, are just further examples of the need for research in this whole problem of water.

We likewise concur with the need for an early inventory of our water supplies, and our water uses, and our water needs for the future. We think it is one of the early musts in a water-management program for this State.

We likewise subscribe to the efforts to control pollution, the purification of water, and its reuse, because we recognize that in these same areas where people, industry, recreation, agriculture, all exist that the necessity for reuse of water is one of the prime management techniques.

We likewise concur with the need for flood plain protection. It is especially true of our interest in flood control work, not only for the problem where housing has moved into flood plain areas but where industry and business had a tendency to pinch in our streams and waterways and accelerate many flood hazards.

We likewise concur with the State's responsibility in meeting the water-use-rights problem.

Moving back to the land itself water falls largely upon land. Perhaps 98 percent of our waterfall in the continent section itself falls upon land. We therefore believe that the management of the raindrops must start with the fall, that is on the land itself.

Previous speakers have indicated that in our State about 30 percent of our rainfall runs off. This runoff is not uniform. Much of it occurs during the early part of the year, earlier through snowmelts and heavy early rainfall at a time when the greatest needs of agriculture, recreation, industry, and domestic use does not take place.

We could use some of that water come July and August. So our runoff is not uniform.

When this water is lost from our lands, we not only loss it from our crops, but it presents problems of drainage to us and we have hundreds of thousands of acres in Michigan that need much more drainage to be most efficient.

We are presented with limited flooding areas and while we in Michigan are not subjected to the type of flooding that occurs in other parts of the United States, we do have flooding areas on a limited basis, and to those people who own lands, who own homes, own industry in towns, that flooding is as important to them as any flooding that occurs anywhere else in the United States.

We have problems of siltation, and this siltation, of course, not only means the loss of soil from the land itself and reduction in its productivity, but it also means the pollution of streams and lakes which adversely affect the quality of water not only for industrial and domestic use, but also for fish and other recreational uses.

We know of the efforts of the department of conservation. We are working very closely with them on just that aspect of sediment control itself, to improve the quality of our waters for recreation purposes.

Likewise when that water is lost it is lost to us for the possibility of irrigation.

The previous speaker has made some reference to the possibility of irrigation. So far as our agricultural production is concerned, probably the greatest opportunity that exists for increasing efficiency in production comes to the addition of water. Water, through irrigation, offers one of the greatest possibilities we have in that direction. That has been amply demonstrated to date.

Soil conservation practices, of which we are primarily concerned, must be a necessary supplement to other controlled measures. We must start controlling the raindrop where it falls on the land. Most of our soil conservation practices are aimed at surface water management.

Our change shifts in land use, our increased emphasis on vegetation, including grass, legumes, forest growth, our supplemental practices of contour cultivation, terracing, those items have one objective in mind and that is to control the surface movement of water which we hope by walking it off the land or slowing it up, we can get greater infiltration, get less sedimentation, and we will have less total runoff.

The point has been made that we have 76 soil conservation districts in Michigan. We believe they are effective. We are appreciative of the assistance which the Congress has provided through the Soil Conservation Service, through the public forestry agencies, including the Forest Service. We would like to point out that while 33,000 of our farmers are cooperators in districts in Michigan, that there is a backlog of several thousand who are not able to obtain the assistance because of the lack of the technical help which has not kept pace with the development of interest on the part of farm people or the spread in numbers of our soil conservation districts.

We think not only is more of that technical help available and needed for our districts, but it is quite evident, too, that additional assistance from our public forestry agencies, is highly needed and desirable because a great deal of our land involved is in forestry production.

Reference is also made to upstream watershed projects under congressional Act 566. We have six such projects underway in this State, approved for planning but no construction on any of them has occurred yet.

We are expecting, however, that construction will take place within a few months on some of the projects.

Insofar as our experience to date is concerned, we concur with the cost-sharing policy of the Congress, its relationship between the Federal Government and its assistance to local governments in the upstream watershed work. We believe that that is sound. We have not had a chance to apply it but we believe the principle of cost-sharing relationship is sound and we subscribe to that particular effort.

We do believe that some consideration should be given to the relationship of intangible returns from watershed work in determining the cost-benefit ratios to be derived from the projects.

Lastly, we know we cannot proceed any faster than our public is willing to accept our services and our efforts. We would call attention to all efforts on the part of Government agencies, locally interested groups, local facilities, such as the press, the radio, television, and others, to work together and help all of us in this gigantic task of

helping the people become informed because we do not believe that there is any substitute for an informed public.

Thank you, Senator.

Senator HART. Thank you.

If time permitted, and we could drum up an audience, I think the people of the city of Detroit and any metropolitan center would be the better off if they were exposed to a half a day of an outline of the way the soil conservation districts are organized and the enormous amount of real talent that is contributed to the operation by the farmer involved. I must confess it was news to me.

It is one of the finest experiences I have had as a result of this job.

Mr. HILL. Thank you, Senator.

Senator HART. Thank you very much.

James L. Rouman, for the Michigan United Conservation Clubs.

Have we a spokesman from the Michigan United Conservation Clubs?

They have filed a statement which will be made a part of the record.

(The information referred to follows:)

STATEMENT OF JAMES L. ROUMAN, EXECUTIVE DIRECTOR, MICHIGAN UNITED CONSERVATION CLUBS

Mr. Chairman and members of the committee, my name is James L. Rouman, executive director of Michigan United Conservation Clubs, which is a statewide conservation organization made up of better than 320 affiliated clubs, with an approximate total membership of 60,000. As a representative of the organized sportsmen of Michigan, we welcome the opportunity to present briefly information regarding Michigan's water resources. We would also like to take this opportunity to express our appreciation for arrangements that have been made regarding this meeting. You are now located in the heart of the Great Lakes Basin, the largest body of fresh water in the Nation. Even so, with the great abundance of water which virtually surrounds and covers the State of Michigan, it is often difficult to bring to the realization of the peoples of this State that Michigan does have a very real water problem. We know that the committee's work here today will do much to focus attention on the development of one of Michigan's most important resources.

Without a doubt, other organizations, agencies, and individuals will discuss many of the varied problems relating to water development in Michigan. Municipalities will cover the need for sewage disposal, agriculture will relate irrigation requirements, industry will call attention to water needs for future expansion, the St. Lawrence Seaway authorities will highlight water and transportation—but we would like to discuss briefly one of the developments that reaches every level of our population. We refer to the recreational use of water as it applies to our human resource.

Unfortunately, in the past, water development for recreation has not always been given its proper place on the priority list. Too often we think of our water resources on an economic standard only. Even so, if we must discuss water in terms of dollars and cents, we should call your attention to the fact that the second largest industry in this State is our tourist industry, which is, of course, based on the recreational resources of Michigan. Michigan's multimillion dollar ($650 million) tourist industry is closely geared to its water resources, which includes 36,000 miles of rivers and streams, 11,000 inland lakes and 3,000 miles of Great Lakes shoreline—truly a "water wonderland." Closely related to our flourishing tourist business, water supports fish and wildlife populations which have vaulted Michigan into the top spot in the Nation. Since 1954 it has reigned as the most popular State for hunters and fishermen. Little wonder Michigan is called the fisherman's paradise.

However impressive and economically important is our ever-growing tourist industry, we must call attention to another vital resource involved. I refer to the personal well-being of the people of Michigan—our human resource.

In our shrinking world, with an ever-increasing population growth and complex society, it is most imperative that we provide adequately for the recreational outlets of our people.

The tremendous increase in boating, fishing, camping, and general use of outdoors in Michigan is evidence of the importance of the intangible asset of our water resources. These intangible values cannot be physically described or measured, for no one has come up with a yardstick capable of evaluating in dollars and cents the self-satisfaction derived through outdoor recreation. It is difficult to place an economic value on the esthetic contributions resulting from a fishing or boating trip. As time goes on, these esthetic values will become increasingly more important. Water development for recreation is needed now, and certainly the need will increase in the years to come.

In your consideration for future water development and possible proposed legislation, we would like to call your attention to the Michigan water rights legislation. Generally speaking, Michigan's water laws are among the best in the Nation so far as the protection of public rights and interest is concerned. This came about as a result of the many common laws we have which have been based on Supreme Court decisions favoring the use of public waters to the benefit of the public welfare, and holding these waters as a trust for all. The so-called riparian doctrine of reasonable use generally applies to all water controversies arising in this State. In this respect, the organized sportsmen of Michigan must insist that any attempt to alter this philosophy of riparian ownership would not be in the best interest of the public. Specifically, therefore, we cannot condone any attempts to supplant this riparian philosophy with the appropriation doctrine as used in other parts of the Nation. There is no question but that water legislation and water development considerations will bring about some necessary adjustments and changes, but the backbone of any new water development structure must be based on the riparian doctrine.

With reference to Federal legislation, the organized sportsmen and conservation minded people of Michigan watched with great interest the progress of H.R. 1 (commonly referred to as the Chicago water diversion bill) in the 86th Congress. Michigan United Conservation Clubs has for many years in annual convention gone on record as opposed to this unjust legislation. It is our opinion that to divert Great Lakes water would result in a precedent setting action most detrimental to the future of water development in our Great Lakes Basin. Michigan has been in the thick of the fight every year with Attorney General Paul Adams, and Assistant Attorney General Nicholas V. Olds, and Water Resources Secretary Milton Adams, spearheading the legal battle. Michigan Senators McNamara and Hart played a most important role in the Senate stalling action on the passage of H.R. 1. Also, the Michigan delegation in the House of Representatives put aside party politics and voted in unison against the Chicago water diversion bill. This conservation minded attitude of our Michigan Congressmen is held in high esteem by the organized sportsmen of Michigan. They are to be commended for their aggressive stand.

We also believe that continued long range research is necessary in order to manage wisely the water resources of this State. We heartily endorse such projects presently in operation by the U.S. Forest Service in conjunction with the Fish Division of the Michigan Conservation Department, with reference to forest areas and our related future water tables.

Also, extensive water research on our Great Lakes waters is a prerequisite to any large-scale attempts at fish repopulation

Continued Federal aid and appropriations are needed to continue the job of pollution control in order to insure adequate and clean water.

"Save Our Shorelines" is the title of a bill introduced in Congress by 18 Senators, including McNamara and Hart, which would "save and preserve, for public use and benefit, certain portions of shoreline areas of the United States". Michigan United Conservation Clubs highly endorses this proposed legislation, which is an outstanding example of wise planning for our future needs.

There are many other ramifications of water development of great concern to the conservationist—but most emphatically we would once again emphasize the importance of the recreational aspects of water development as it affects all people.

We sincerely urge that these recreation facets of water development be considered in true perspective, and granted a high priority with respect to future plans and consideration by this committee.

Senator HART. Expressing the view of industry which has not been heard to date but which in the course of some of the testimony here this morning has been referred to, Dr. Van Horn, from Appleton, Wis., who is appearing on behalf of the Institute of Paper Chemistry.

STATEMENT OF DR. WILLIS VAN HORN, REPRESENTING THE INSTITUTE OF PAPER CHEMISTRY

Dr. VAN HORN. Thank you, Senator.

May I say I am very happy to be here.

Senator HART. Glad to have you.

Dr. VAN HORN. I hope what I have to say you will find useful.

I have been asked by the attorney from my organization to say this for the record. The Institute of Paper Chemistry is a tax-free institution. I hope that it will be understood that my appearance is not to be construed as an attempt to influence legislation.

Senator HART. A very wise counsel.

Dr. VAN HORN. But rather to present information to your committee which I hope you will find useful.

In reviewing the letter that you wrote to our president, Senator, it seemed to me that I could best serve this purpose of this meeting by discussing briefly what water pollution means to the pulp and paper industry and what is being done about it.

What I have to say is pertinent not only to the Lake States region because there are extensive pulp and paper installations in Michigan, Wisconsin, Ohio, Indiana, and Minnesota, but it is also pertinent to any other area of the United States in which pulp and paper is manufactured, whch includes the South, the Northeast, and the Northwest.

In preparing this report I have based my record for you on a review article that I prepared some years ago. I have included that in the report and have substantiated it with calculations. This will be a part of the permanent file you requested.

Senator HART. Thank you.

Dr. VAN HORN. I wish to request, however, that you permit me to present to you a supplementary report because my report is 7 years old and a lot has happened since then.

Senator HART. We will be glad to have that.

Dr. VAN HORN. The dilemma of the pulp and paper industry concerning water resources and water use can be simply and clearly stated. Wood and water are the true principal raw materials of this industry. The wood resource has been renewable. Under current forestry, management practices, it is apparent that an adequate supply of this raw material will be available to us in the years that lie ahead.

Water, on the other hand, is a stable resource. We have only so much. We cannot add to it or detract from the total amount. While many attempts have been made the pulp and paper industry has not yet learned how to convert wood to paper without using large amounts of water. This water is not used up. It is only used and is returned to the stream.

For example, it takes from 25,000 to 75,000 gallons of water to make a ton of pulp, from 10,000 to 15,000 gallons of water are required to convert a ton of pulp to paper. I have not seen the latest figure, but the last figure I saw was that the total water use for the pulp and paper industry in the United States is in excess of 3 billion gallons per day.

Wood consists of about 48 percent fiber and the rest of the wood is nonfibrous. We only use the fibrous part of the wood in the manufacture of paper. That, therefore, anywhere from 30, 40, to 50 percent of the wood becomes in a sense waste.

This waste material may contain sugar, wood sugar, which is just the same as cane sugar or beet sugar or any other type of sugar and when this waste material is passed to the stream it can have one or more of three possible effects.

The first effect of this waste or any other kind of waste as far as that is concerned is that it may cause a depletion in the dissolved oxygen concentration of the stream up to the point where the environmental conditions of the stream become hazardous to fish and other aquatic forms.

Waste may also contain materials which are poisonous or toxic which if present in high enough amounts will destroy the organisms in the water and finally a waste may contain inert materials which will destroy the aquatic environment.

As far as the pulp and paper industry is concerned the biggest and most troublesome problem is maintaining an oxygen balance in the receiving water. That is to say, maintaining enough oxygen in the water so that the fish and other forms of aquatic life will not be adversely affected.

We have several types of processes in the industry, one of which is called the sulfite process for making pulp, and a ton of sulfite pulp may remove from the receiving waters up to as much as 500 pounds of oxygen per ton. Kraft pulp, which is a different kind, in which there is a recovery system may require only as much as 100 pounds of oxygen.

In the recent years a third type of pulping operation has been developed which is called neutral sulfite, semichemical. This requires from 200 to 300 pounds of oxygen. This will be of interest to those living in the Kalamazoo Valley. When you deink pulp, that is when you use waste pulp and deink it before you use the pulp to make paper, this operation may require from 50 to 150 pounds of oxygen per ton of waste paper pulped. These pulping wastes, therefore, constitute the most serious problem of the pulp and paper industry.

As far as making paper is concerned, it only requires about 20 pounds of oxygen from the stream to make a ton of paper.

Now, as I say, this oxygen problem is really the most important one that we have. The industry has organized itself in several different ways but in all ways the purpose is to concentrate on this matter of stream improvement.

Some of the organizations which are involved in this and which are closely affiliated with the industry are, first, the National Council for Stream Improvement in New York, which is an organization of all the pulp and papermakers in the country. A similar institution is my own, the Institute of Paper Chemistry in Appleton, Wis. On our canvas is another group which is designed to attack this problem of sulfite pulp pollution called the Sulphite Pulp Manufacturers Research League in Appleton, Wis.

In addition to that the industry maintains many research projects at various universities and notably at the University of Washington in Seattle, or State college in Corvallis; the Louisiana State University in Baton Rouge; Rutgers University in New Brunswick, N.J.

The University of Michigan, of course, and the University of Wisconsin, and the University of Minnesota, are also having research projects.

These people are working in a general way.

In addition to that, of course, many individual companies are working on the problem, and in their own laboratories they have made some real progress.

I would like to cite—for example, the Weyerhaeuser Co. in Washington has developed a process using magnesium instead of calcium in the sulfite process. This permits reduction of pollution by 90 percent.

The Marathon Division of American Can Co. has a long program of utilization, and they now have a very going concern in manufacturing such things as oil well drilling muggs, ethyl vanillate, and synthetic vanolene. Crown Zellerbach are doing work on recovery of certain chemicals from the waste which is the result of reducing pollution.

Here in the Kalamazoo Valley there is a very interesting operation going on in which these mills are pioneering in the treatment of waste by the use of an activated sludge operation.

The Kimberly-Clark Corp. in Wisconsin has pioneered in using the pumping waste for road binders and putting them on dusty roads for settling of dust. They also have pioneered in the method of land disposal.

In the desulfite pulp manufacturers research league in Wisconsin has also resulted in the development of rowing fodder easier from spent liquor and this fodder is an important adjunct to cattle feed, poultry feed, and so forth. They have also pioneered in the method for evaporating and burning these wastes in a manner similar to that which is conventional for the craft industry.

So that the pollution potentials of the waste is reduced up to 90 percent.

I cite these things not boastfully but simply to advise you that some progress is being made in this problem of stream pollution as far as the pulp and paper industry is concerned.

As far as my own organization is concerned, our contribution has been chiefly in the area of neutral sulfite, semichemical pulping in which we developed the method for recovery and burning of this liquor.

It seems to me that I should say something a little bit about the problem of toxicity since I brought it up. Really this problem is not very common in the pulp and paper industry. We know what substances are toxic and we know how to recover them by and large so they are not permitted to go to the stream. One of our big problems which is less serious now than it was in former years is the problem of letting waste fibers into the stream creating fiber beds on the bottom of that stream. We have modern vacuum equipment now for washing pulp and most of the fiber deposition that we found now are laid down before such equipment was invented.

Nevertheless, we do use a certain amount of fibers for stream in spite of everything that we can do. In this case it is a problem where the stream is small and there are no brushes to flush it out to the sea. I do not want to give you the impression, as I said, that we are in the clear as an industry. We certainly are not. We have done a great deal. We have a great deal more to do, but we are giving it a very real effort.

We are in hopes that the time will come when we can use the water along with everyone else and not impair its quality for any other use.

Thank you very much.

Senator HART. Thank you, Doctor.

To respond seriously to the safeguarding note you opened on as a result of your lawyer's recommendation, I should make clear that I suggested to the committee, and it was the committee's desire, to have you here because we seek not to point fingers, but we all share the problem, and an industry which contributes so much employment to Michigan certainly has its side to tell.

Dr. VAN HORN. I appreciate that very much, Senator. This, of course, as you know, is a legal device to put us in the clear as far as the Bureau of Internal Revenue was concerned.

Senator HART. I understand. I should add, Doctor, if you will file that updating of the statement within 30 days——

Mr. VAN HORN. I will do my best.

Senator HART. In order that we can have it for the record.

(The report referred to above follows:)

PROGRESS IN STREAM IMPROVEMENT

(By Willis M. Van Horn, The Institute of Paper Chemistry, Appleton, Wis.)

In this report—reprinted from the March, April, and June 1953 issues of the Paper Industry—an effort has been made to confine attention to those developments that have been proven either by full-scale commercial operation or, at least, by pilot plant operation. Part 1 deals with the spent sulfite liquor problem, part 2 with kraft, semichemical, straw and deinking wastes, and part 3 with paper mill wastes and methods for the measurement of stream quality.

Large amounts of water are necessary for the manufacture of pulp and paper. This water is not a part of the final product but is used, as an example, as a medium of pulp refining and sheet formation. During its use, solids are added to it, either in solution or in suspension. After its use, when the water is returned to the stream, these solids often cause stream pollution.

There are at least three ways by which any waste can affect a stream and its inhabitants. First, the waste may contain toxic substances that will destroy the acquatic animals and/or plants; second, it may contain materials having a biochemical oxygen demand (B.O.D.) high enough to lower the dissolved oxygen level in the stream to a hazardous point; third, the waste may contain inert solids that, by their very physical effect, may render the stream uninhabitable to its normal population.

In approaching its stream improvement problem, the pulp and paper industry has had to direct its attention to all three of these phases of stream economy. Of the three, the one that is most commonly and probably the most serious is the problem of maintaining an adequate oxygen balance in the receiving waters. The oxygen problem is caused, of course, by the fact that the papermaker is interested only in the fibrous components of the raw material—the lignin, sugars, and other encrusting materials are of little value, except perhaps in some of the newer processes involving high-yield pulps; of these materials the sugars have a high oxygen demand.

Except in a few isolated cases, there is no industrywide problem of toxicity. In the case of kraft pulping, there may be toxic wastes, but these are diluted to a point below hazardous levels when they are passed to the stream.

The problem of inert solids also seems less serious, on an industrywide basis, than that of oxygen depletion. Excessive fiber loss may create a stream nuisance, but modern practices of the use of savealls of increased efficiency have, in most cases, reduced such loss to a minimum. Deinking wastes may also contain appreciable amounts of inert materials.

On an industrywide basis, therefore, the major problem is concerned with the use of the streams without causing oxygen depletion to a point inimical to the livelihood of fish and other aquatic forms. This problem is probably the most

serious in those segments of the industry employing acid (calcium base sulfite) and neutral sulfite or other modified semichemical processes. In addition, kraft pulp mill wastes although having a moderate B.O.D. value, are sometimes discharged in such large volume that their B.O.D. may be a problem, especially where the mill is located on a small stream. First attention is given, then, to oxygen balance.

PART 1—THE SPENT SULFITE LIQUOR PROBLEM

Activity in this pase of the industry's stream improvement problem has been especially vigorous in the past few years. Much research has been done on a variety of ways of either utilizing or disposing of this troublesome waste. The problem is greatly complicated by the large amounts of material which must be disposed of, and also by the economics of the sulfite operation.

Howard (1, 2) and Abrams (3, 4) have discussed the development of the Howard process at Marathon Corp. by which valuable products are recovered from spent sulfite liquor. In this process the sulfite is recovered as calcium sulfite and the lignin becomes available as a solid. From this lignin, vanillin, dispersing agents, tanning agents, and other products are manufactured. Lewis (5) has discussed further the many uses to which lignin can be put, such as in the manufacture of adhesives, corebinders, insecticides, dyes and dyeing, electroplating, emulsions, fermentation, fertilizers, plastics, soaps, etc. At the same time, he pointed out that the sulfide industry in the United States has to dispose of about 2,500,000 tons of lignin a year. The uses described above, tonnagewise, would not require enough lignin to generally improve the stream problem.

And so, in the past few years, more and more attention has been paid to the possibility of burning spent liquor with enough heat recovery to make the process economically feasible.

The evaporation and burning of spent sulfite liquor is not a new proposition. Mills in Pennsylvania and other States have had equipment installed for years and have marketed various liquor concentrates.

More recently the sulfite mills in Wisconsin and Detroit Sulphite Pulp & Paper Co., through their Sulphite Pulp Manufacturers' Research League, have become interested in the Rosenblad evaporator (6). A pilot plant was set up at Appleton (7, 8) which has demonstrated that the calcium base liquor can be evaporated as well as burned. Currently such plants are under construction at Northern Paper Mills, Green Bay, Consolidated Water Power & Paper Co. at Appleton, and Rhinelander Paper Co. at Rhinelander. The installation at Rhinelander has been placed in operation (8A).

Tilghman in his original patent (9) said, "I have found that the addition of sulfite or bisulfite or lime, or other suitable base, to the acid solution tends to make the fibrous product of a whiter color and more easily bleached." Dieckmann (Sulfitzellstoff, 1923) states that Tilghman's first English patent covers calcium, magnesium, and sodium. It was not until comparatively recently, however, that interest in magnesium as a base, in a commercial operation, was developed. The work of Hatch (10, 11, 12), Tomlinson and Wilcoxson (13, 14), Tomlinson (15), and Wilcoxson (16) led to the establishment of the first commercial-scale magnesia base plant in the United States—that of the Weyerhaeuser Timber Co. at Longview, Wash. (17, 18, 19). It does not fall within the scope of this paper to discuss the economic aspects of this operation. From a stream pollution point of view, however (the author is indebted to the Weyerhaeuser people for permission to publish this fact), the B.O.D. loading in pounds per ton of MgO bleached pulp is slightly lower than the average for well-operated bleached kraft pulp mills. If the original purpose of the development was to abate stream pollution, then it must be considered a success.

It has been stated (20) that the new mill of Ketchikan Pulp Co. at Ward's Cove, Alaska, will employ the magnesium-base process.

The use of ammonia as a base in the sulfite pulping process also has stream improvement implications. A news item (21) in 1945 stated that the Shelton, Wash., division of Rayonier Inc., would use ammonia, instead of lime, as the base for the pulping system, and that the waste liquor would be evaporated and burned. The article also stated that the Shelton installation was the first commercial application of the process on the North American continent.

La Fond and Holzer (22) have described the conversion of the Crown Zellerbach Corp. plant at Lebanon, Oreg., from calcium to ammonium base. Palmrose and Hull (23) and Waddell (24) have considered the problem of evaporating and burning the spent liquor at this plant. They have operated a pilot plant

on a basis of liquor from 10 tons of pulp per 24 hours with statisfactory results. When these results are translated into a successful commercial operation, another milestone will have been reached in the progress of stream improvement.

Use of spent sulfite liquor in road treatment

In the United States spent sulfite liquor has been used as a road binder for many years. One of the first places it was so used was in and around Spokane, Wash.

It has also been used successfully nearer the west coast (25, 26). Sherman (27) discussed the experience of the Flambeau Paper Division, Park Falls, Wis., since 1944 in using spent sulfite liquor at 10 percent dry solids as a road binder. He states that such a treatment is very successful on gravel and dirt roads, if the soil is properly prepared. It not only makes a good road in itself, but it can also we used in preparing beds for blacktop or bituminous surfaced roads. It is calculated that the cost of a 100-mile haul (in 1950) was $16 per 1,000 gallons. Although the character of the soil varies considerably, a yardstick of 10,000 gallons per mile per year is given.

It is also reported (28) that the application of hot-spent sulfite liquor to icy roads will pit the glaze and cause an abrasive (sand or cinders) to remain in place after application. The proper procedure is to have the sanding truck follow immediately the tank truck which is spreading the spent liquor.

In the community in and around Appleton the author has observed that "Road-binder" trucks are only a little less common than milk trucks. In 1951 some 23 million gallons, and in 1952, 30 million gallons, of spent liquor were spread on Wisconsin roads (29, 30).

It has long been known that the sugars in spent sulfite liquor can be fermented to alcohol and other related compounds. Such alcohol is being produced at Bellingham, Wash., (31) and in Canada (32, 33).

Fermentation process

More recently in the fermentation field attention has been directed to the production of fodder yeast from spent sulfite liquor. Many workers have for years investigated the feasibility of making yeast in this way, and several plants have been built abroad. In the United States the program of the Sulphite Pulp Manufacturers' Research League (34, 35), utilizing *Torulopsis utilis*, culminated in the erection of a fodder yeast plant at Rhinelander (36).

The economic feasibility of yeast production, in those cases where the product must compete marketwise with crop fodder, has not as yet been finally determined. In the north European countries, where the amount of forage crops is not as large as in the United States, the success is more certain. From the standpoint of basic nutrition, the yeast process is sound, because it transforms a large amount of unavailable carbohydrate material into available protein material. In an expanding economy, both from the standpoint of population, social and nutritional needs, a new source of protein is bound to be significant, sooner or later.

It is noted that one company, which formerly planned to install an evaporation and burning plant to abate its pollution problem, has changed its plans and will build a yeast plant instead (37).

Pharmaceuticals from spent sulfite liquor

One way, in theory at least, to abate the spent sulfite liquor pollution problem is to make it economically attractive to recover and use the lignin in that liquor. Although lignin itself does not have a high pollutional effect, its recovery automatically removes those liquor elements, the sugars, that do.

The Marathon plant at Rothschild, Wis., has established an impressive record in the field of lignin utilization and, therefore, stream pollution abatement (1–4).

The Sulphite Pulp Manufacturers' Research League has been active in this field also. A research program directed to a study of the derivatives of lignin has been maintained at the Institute of Paper Chemistry for many years. Pearl (38, 39) succeeded in establishing the production of vanillic acid on a practical basis and then prepared a number of its esters. One of these, ethyl vanillate, is of special interest. It exhibits specific fungistatic and/or fungicidal properties. Christie et al. (40) and Mitchell and Hiss (41) have used it with success in the treatment of histoplasmosis, an internal fungal respiratory disease which heretofore, in its acute condition, had defied remedial therapy. Ellis et al. (42) have similarly reported success. Ethyl vanillate also shows promise in treating

valley fever (coccidioidomycosis), and airborne fungus spore disease which has shown increasing incidence in the San Joaquin Valley and other areas of California (43).

Pearl and McCoy (44, 45) have shown that, because it is effective in controlling spore-forming and heat resistant bacteria and molds, ethyl vanillate can be effectively used in preserving certain foods, especially bread, cheese spreads, fish and fruit juices.

Disposal of spent sulfite liquor by dilution

In the United States the most common method of disposing of spent sulfite liquor is still the dilution method. Where adequate amounts of receiving water are available, this method is satisfactory. Some streams are large enough to absorb the wastes at all times of the year except the warm weather periods with resulting low water. A mill located on such a stream would not be justified in making a large capital expenditures, as in the case of an evaporation and burning plant, just to take care of its wastes, say, for 3 months of each year. In such situations the process of disposal by dilution has been accelerated or ameliorated by a number of measures, seasonal in nature.

For example, Lawrance (46) has found that the seasonal odor conditions arising each summer from the impoundment of spent sulfite liquor polluted water in the Gulf Island Reservoir on the Androscoggin River can be corrected and eliminated by the addition of sodium nitrate. He stated that in the summer of 1949 a total of 641.5 tons of sodium nitrate was placed in the river over a period of 44 days. It should be noted that, during critical periods, the mills are required to reduce production by a percentage calculated to be necessary to eliminate the trouble.

Wiley, et al. (47) have described an entirely different procedure for taking care of a unique local situation on the Flambeau River. Employing carborundum diffusers with a total area of 319 square feet, set at a depth of 10 feet and fed by a compressor which could supply 1,550 cubic feet of air per minute at a pressure of 5 pounds per square inch, it was possible to add to the stream an average of 1.5 tons of oxygen per day at a streamflow of 880 cubic feet per second. This procedure caused an upstream movement of the zone of recovery.

These two cases are unique in the sulfite industry.

There are several installations in the United States where spent sulfite liquor is seasonally impounded for subsequent release when the receiving stream is high enough to provide water adequate in amount to utilize the dilution method without any troublesome results.

One other development is worthy of mention. In some mills extensive pipelines have been built to carry the spent sulfite liquor to a place where adequate dilution is possible. Two notable cases of this are at Camas and at Everett, Wash. (48). Dispersal of this waste from these lines is facilitated by diffusers; that is, the terminal section of the line has numerous spaced openings situated in a way that the liquor is spread over a relatively large area.

Summary of spent sulfite liquor problem

During the past few years the major developments and installations for disposing of spent liquor have been related to (*a*) evaporation and burning either with or without a change from calcium as a base, (*b*) further development in the utilization of lignin, (*c*) development of specialized fermentations, such as yeast production, (*d*) use of the liquor in building and stabilizing dirt, sand, or gravel roads, and (*e*) exploitation of the dilution method. Which of these developments is best suited to any one mill or condition can be determined only after a thoroughgoing assessment of the conditions in that mill.

PART 2—PROBLEMS RESULTING FROM SULFATE SEMICHEMICAL AND STRAW PULPING AND DEINKING

Because of the fundamental nature of the kraft process, where the spent cooking liquor is recovered, its chemicals reused, and its organic content burned in recovery furnaces, the pollutional effect of this process is not as great as in the sulfite process. For example, the B.O.D. loading per ton of bleached sulfite pulp produced may be as high as 400 pounds. On the other hand, the manufacture of bleached kraft usually results in B.O.D. loadings of 50 to 100 pounds per ton. When a medium-sized mill is located on a large stream, waste disposal by dilution is usually satisfactory. On smaller streams, however, kraft mill waste may cause trouble.

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An examination of a typical kraft pulpmill waste indicates that it contains several components which may be troublesome from the point of stream sanitation.

One source of possible trouble may be from the relief and evaporator condensates. These waters contain relatively high amounts of materials such as sulfides and mercaptans which, although not having an appreciable B.O.D., may be toxic to aquatic forms if present in sufficient amounts. Another source of possible trouble is in the dilute wash water that, because of its low chemical content, is sent to the sewer instead of the recovery system.

The potentially toxic aspects of kraft pulpmill wastes has been discussed by Ebeling (49), Cole (50), Hagman (51), Bergström and Vallin (52), Bergström (53), and Extrom and Farner (54).

In their work for the National Council for Stream Improvement, Van Horn, Anderson, and Katz (55) established the minimum lethal concentration of the sulfides, mercaptans, sulfate soap, resin acid, and sodium hydroxide to more sensitive species of warm water fish and fish food organisms. They also devised methods for measuring these compounds in mill effluents and made extensive analyses of the waste waters of five typical northern kraft mills. Using the dilution ratio of waste volume to stream discharge volume, it was possible to calculate the river concentration of the various components after dilution and thus determine if the potentially toxic compounds existed in hazardous amounts in the river.

It is possible to remove these potentially toxic materials from the digester relief and evaporator condensates if the situation requires it. Bergström and Trobeck (56) have described a method of countercurrent scrubbing by stack gases in a wooden stave tower. They state that the amount of sulfides in the condensates are greatly reduced. Allen (57) described the installation of such a tower at the Weyerhaeuser Timber Co. mill at Springfield, Oreg.

Notwithstanding the fact that good operation of a kraft mill will result in sending most of the black liquor to the recovery, some of it escapes to the stream and may cause oxygen depletion therein. As indicated above, the B.O.D. loading from a kraft pulp mill varies from 50 to 100 pounds per ton depending on the degree of bleaching.

The national council has maintained an active and vigorous program over the past years which is designed to resolve the problem of the effect of these wastes on the oxygen balance in the stream. Gehm (58) has stated that their program on this problem has followed two lines of approach: (I) biological treatments at higher efficiencies which require more compact systems than those presently employed and (II) chemical-treatment systems, which allow integration with pulpmill recovery systems. Phase I has been reported by Moggio (59), Barnes, Moggio, and Colmer (60), and Moggio and Gehm (61). These reports indicate that fortifying the mill waste with nitrogen and phosphate salts and seeding with organisms from the mill wastes diminished the amount of aeration necessary and hastened the rate at which B.O.D. removals were obtained. For short periods of aeration (8 hours or less), the rate of B.O.D. removal was only slighty less than with longer periods (24 hours). The commercial feasibility of this process will be determined after an adequate pilot plant study.

The chemical-treatment approach (phase II, above) has been reported by Moggio (62). He stated that the greatest disadvantage of all processes examined was the excessive cost of treatment, coupled with the problem of handling and disposing of the large quantities of sludge produced. One possible exception to these objections may be found in a treatment involving excess lime and carbonation, followed by the recovery of the lime in the precipitated sludge. The article stated further that the development of an easily dewatered sludge and control methods is essential to the success of any chemical-treatment method.

In recent years much attention has been paid the use of oxidation and/or impounding lagoons for the disposal of kraft waste liquors.

Crawford (63) has described his experiences at Camp Manufacturing Co. in Franklin, Va. The strongest wastes were impounded during period of low water flow for discharge when the river was higher. During the time that these wastes were in the pond there was an appreciable drop in their B.O.D.

Porter and Bishop (64) have reported on the work done at Southland Paper Mills, Inc., at Lufkin, Tex. The total mill effluent at this mill is a combination of wastes from a kraft pulpmill, bleach plant, groundwood pulpmill, newsprint machine, and cylinder board machine. Treatment consists of a settling basin to remove suspended solids and two large oxidation ponds. The overall reduction in B.O.D. is in excess of 70 percent.

The problem of semichemical spent liquors

The third major stream improvement problem facing the pulp and paper industry—one which is becoming more and more important—is that of the disposal or utilization of spent semichemical liquors. Of these, the liquors resulting from the neutral sulfite process are of great interest because of the widespread use of that process.

The problem of spent neutral sulfite liquor is mainly one of its B.O.D. This may range from 150 to 250 pounds per ton of product.

Sapp (65) stated that, where neutral sulfite mills are operated in close conjunction with kraft mills, it is possible to pass some of the neutral sulfite liquor to the black liquor recovery system. This has its limitations, however, since the ratio of neutral sulfite liquor to kraft liquor may not exceed, it is understood, the 1:4 value.

The national council (66) is conducting a research program for finding ways of disposing of neutral sulfite liquor. This program has been directed toward finding a more economical way of evaporating the liquor.

There is some interest in the industry in segregating and lagooning the stronger wastes from the neutral sulfite operation. Where this has been done there is an improvement in the oxygen balance of the receiving water. One possible drawback of this method of disposal is the fact that the wastes may develop an unpleasant odor during the period of their impoundment.

The problem of deinking wastes

The objectionable properties of deinking wastes from the standpoint of stream economy are: (1) quantities of suspended solids which cause high turbidity in the receiving water and which might cause sludge deposits under certain conditions; (2) the B.O.D. of the wastes and (3) the muddy gray to almost black color which may adversely affect the aesthetic qualities of the receiving water (67).

Morgan (68), working with the national council, devised a laboratory-scale treatment for deinking wastes involving biological treatment. From this work a pilot plant was developed at the Plainwell mill of Michigan Paper Co. (69–71).

A commercial scale plant was later built by Kalamazoo River Improvement Co. at Plainwell (72). Its design and operation have been discussed in detail by Palladino (73–75).

A primary treatment deinking waste plant at Falulah Paper Co. is described by Palladino and Baigas (76).

It is anticipated that the Plainwell plant will remove in the neighborhood of 70 percent of the B.O.D (75). One problem that derives from its operation is that of sludge disposal and this problem has been discussed by Palladino and Baigas (76) and by Kalamazoo River Improvement Co. (77).

There is little doubt that this work provides a significant approach to one of the more troublesome of pulping pollution problems.

The problem of straw pulping wastes

Working under the sponsorship of the national council, Bloodgood and Erganian (78) have described the pollutional properties of straw pulping wastes and found that, on a laboratory scale, there was 80 percent reduction of B.O.D. when samples were incubated at 37° C. for 14 days.

Bloodgood and Hargleroad (79) investigated the feasibility of biological treatment of strawboard wastes by using a pilot-scale trickling filter at Terre Haute Paper Co. and concluded that this method was unsatisfactory.

Bloodgood (80) then described a pilot plant designed to treat these wastes by a process anaerobic digestion. This plant had a primary sedimentation tank, sludge digestion tank, secondary settling tank, waste sludge storage tank, and pumping equipment for returning the sludge from the secondary tank to the digestion tank. He found that primary treatment would remove 19 percent of total solids and 30 percent of the B.O.D. and that the overall process would result in an effluent having 150 parts per million or less of B.O.D.

Chene, et al. (81) have described their method of treating straw cook liquors by chemical means. The B.O.D. of lime straw cooking liquor was considerably reduced by treating with an excess of carbon dioxide and neutralizing with lime to a hydrogen-ion concentration of 7.5.

In recent years there has been some renewed interest in treatment of strawboard mill wastes by ponding. Such oxidation ponds are discussed in general and in principle by the American Public Health Association (82). Krancher

(83) has described his experiences with the lagooning system of Ball Bros. Co. at Noblesville, Ind. He found that there was substantial reduction in B.O.D. and suspended solids, and that the lagoons also afford storage capacity which permits a controlled discharge in a manner to minimize the effect of the waste on the receiving water.

PART 3—PROBLEMS RESULTING FROM PAPER MILL WASTES AND THE MEASUREMENT OF STREAM QUALITY

White water disposal, the perennial problem of the paper industry, has received its share of attention in the overall industrywide campaign for stream improvement. In recent years a great deal of work has been done by individual mills in the phases of closing up the machine systems and recirculating a maximum amount of white water. This has, of course, aggravated the slime control problem, but the latter has been mitigated by extended experience in the use of mill antiseptics.

Coupled with the closing of the machine systems has been the development of improved types of savealls so that, generally speaking, each year has seen some reduction in fiber and other machine losses.

Treatment of white water involves the removal of fines, filler, materials in colloidal suspension, and the like. Generally this treatment has taken the form of three approaches—flotation, sedimentation, and filtration. All three may or may not depend upon the addition of a flocculating agent or agents and, generally speaking, the operating cost is in proportion to the effectiveness of removal (84).

The flotation type of saveall seems to have come into rather wide use in the paper industry over recent years (85, 86). Easton and Baum (87) have discussed the Sveen-Pederson saveall, which is of this type. They stated that experience with more than 100 operating installations in the United States has shown that the primary advantages of the Sveen-Pederson are (1) time of circulation through the saveall is short; (2) the efficiency is high even on heavily loaded or slow stock; (3) the saveall can be easily cleaned; (4) low maintenance cost and no shutdowns; and (5) fluctuations in flow and consistency may be handled. Thompson (88) discussed the installation of this type of saveall at the Milltown, N.J., plant of Personal Products Corp. Each machine has a 500-gallon unit, and the influent contains 18 pounds of stock per 1,000 gallons. It is stated that each unit recovers 6 tons of stock per day, 720,000 gallons of waste per day are treated and clarified, and there is approximately 100 percent solids removal. The cost of chemicals is said to be about $2.95 per ton and the cost of clarifying the water $0.025 per 1,000 gallons.

Richardson (89) discusses further the operation of the Sveen-Pederson type saveall, possible difficulties in its use, and ways of avoiding them.

At least two other flotation types of savealls—the Adka and Savalla—are in use in the paper industry. Niberger and Bodette (90) have described the operation of a Savalla at the Deferiet mill of St. Regis Paper Co., which has an average recovery efficiency of 98 percent.

According to Gustaffson (91), the performance of these two types (Adka and Savalla) closely approximates that of the Sveen-Pederson.

It has long been known that white water can be clarified and fiber recovered by plain settling or sedimentation. Very often this process may be accelerated by the addition of flocculating chemicals. The simplest type of installation is a plain tank acting as a settling basin. The settled solids can be removed in a number of ways (92, 93). Bechtel (94) studied the effect of a number of variables on the rate and completeness of white water sedimentation. By adjusting to a suitable hydrogen-ion concentration, he was able to reduce solids from 5.39 to 0.76 pounds per 1,000 gallons in 30 minutes. Erspamer and Rice (95) described a process involving sedimentation with or without chemical flocculation, followed by a rather rapid process of sludge dewatering and compaction. These authors reported 60 percent reduction in turbidity, 85 percent reduction of suspended solids, and 98 percent reduction of settleable solids by plain settling for 2 hours. Kahn (96) and Kominek (97) described a rapid rate sedimentation unit (Cyclator) which, operating in a board mill, is said to have reduced fiber losses to about 0.1 percent. There are some operational difficulties caused by entrained air or thermal upsets which may entail the installation of additional equipment.

Applebaum (98) has described a "reclaimer" which operates on the principle of the Spaulding precipitator. It operates by upward filtration through a live blanket of suspended solids which it has recovered from the white water. Fiber

recovery is said to be 97 percent. Carpenter and Porter (99) have reported their experience with a Spaulding type precipitator. A 1,200-gallon per minute industrial size unit was developed which takes feed water containing 2 or 3 pounds of solids per thousand gallons and delivers a clarified effluent containing 0.1 pound or less per thousand gallons. It is stated that the operation is continuous and trouble free and that no extraneous chemicals or flucculating agents are required. The accelerator clarifier has also been described (100). This installation, at the Downingtown Paper Manufacturing Co. plant, operates on the principle of increased particle size by recirculation of slurry with incoming raw waste.

Treatment of white water by filtration is carried out in a number of ways. One principle is to pass white water through a screen cylinder by force generated by differential in water levels. As the water passes through a layer of fiber is built up on the screen and this increases the efficiency. One such device, the Waco filter, is described by Wadleigh and Simons (101). Four of these filters are designed to process 600 gallons of waste water per minute on high consistency waste, and may go as high as 1,400 gallons per minute on leaner wastes; 90 percent fiber recovery is accomplished.

The vacuum-type filter has been discussed by King (102). A precoat is formed on the cylinder, as in the case of the Waco but, because of the vacuum, the impelling force may be stronger than if caused by difference in liquid level. Using an Oliver filter for this purpose, Sperry (103) reported a reduction in fiber loss from 8 to 0.46 ton per week. The OCO water system is based on a plate and frame type of filter and a filter aid. Ehemann et al. (104) have discussed this system and stated that it offers a practical solution to the problem of recovery of industrial process water and should offer a means of conserving water, fibers, filler, and heat in white water.

Persons familiar with machine water systems are aware that there is much variation in furnish and, therefore, a resulting variation in the character of white water. A number of different methods and devices have been discussed above, all designed to remove solids from white water. It becomes apparent that the use of any one of these for all types of white water would be impractical. For example, waters containing a high percentage of inert and relatively heavy materials, such as clay, might best be treated by a process where the force of gravity plays an important role. On the other hand, if the solids are of such a nature as to be effectively entrained on a minute air bubble, it is altogether likely that the flotation type of machine would be indicated.

In the last analysis the type of machine to be installed will depend on the type of water to be treated. Coupled with this strictly technical aspect will be the economics of the operation, as well as the effectiveness in producing a final water which can be reused or passed to the stream without ill effects.

Methods for measurement of stream quality

The traditional test employed by sanitary chemists for determining the oxygen demand of sewage is the biochemical oxygen demand (B.O.D.) test. When wastes containing substances available to bacteria and other stream micro-organisms are passed to a stream, the micro-organisms in that stream absorb those substances and oxidize them within their cells. The oxygen so used is "biochemical oxygen," and the amount necessary to completely oxidize the waste is said to be biochemical oxygen demand.

This process, which takes place in the stream, has been simulated in the laboratory to become the B.O.D. test. Under closely controlled conditions the amount of oxygen used by bacterial and other forms in an incubated sample of waste is measured and, from that amount of oxygen, the total oxygen demand can be calculated.

It is obvious that this test depends on the physiological activity of micro-organisms, and it follows that, if the wastes to be measured contain materials toxic to these forms, the results of the test would be misleading.

McGrath (105) has explored the use of this test for measuring the B.O.D. of papermill wastes. She states that, with the best of practices, the method is accurate to within 10 percent, but that it is an excellent measure of what is to be expected when papermill wastes are discharged into a natural stream.

Gehm (106) investigated the uses and shortcomings of the B.O.D. test in relation to its use for pulp and papermill effluents. He made recommendations regarding modifications and discussed the application of the test to specific mill problems. Rogers (107) suggested that the results of the test could be formalized by a simple calculation to 50 percent oxygen depletion.

One of the moot questions concerning the measurement of the oxygen demand of an industrial waste is whether the "oxygen consumed by permanganate" test (O.C.) can be substituted for, or correlated with, the B.O.D. test. Chesley, et al. (108) have made such a correlative study and concluded that, within a range of 54 to 436 parts per million of O.C., B.O.D. values can be reliably calculated. On the other hand Schmidt (109), working with spent sulfite liquor, stated that his data indicate that the methods for determining permanganate consumption are not applicable to the evaluation of pollution characteristics of that waste when it is passed to the stream.

Caldwell and Langelier (110) have described a method for B.O.D. determination of sewage by manometric techniques. They found that the 24-hour oxygen consumption at 25° C., was about the same as 75 percent of the conventional 5-day B.O.D. values. The apparatus for this method—they recommended the use of the Warburg apparatus—is said to provide facililities for controlling variables which heretofore have resulted in inaccurate results. They pointed out, further, that present commercial equipment is expensive and requires a trained operator and expressed the hope that a simple and less expensive modification can be developed.

Over the past few years there has been renewed interest in the use of biology in measuring stream quality. Twenty to thirty years ago the biological method was described by Shelford (111), Richardson (112), Suter and Moore (113), Baker (114), and Turner (115). Interest in it has been renewed in recent years. Papers dealing with the evaluation of stream conditions by this method have been published by Lackey (116), Bartsch (117), Tarzwell (118), Van Horn (119, 120), Patrick (121), Doudoroff (122), Gaufin and Tarzwell (123), and Mills (124). These workers all seem to agree on one point—namely, that biology can be a useful tool in evaluating (*a*) pollution and (*b*) degree of stream improvement. There is some difference of opinion as to which forms are best adapated as "indicators" and the degree to which the method is significant. These divergent opinions appear to have their origin in attempts to generalize the biological approach and in failure to recognize the fact that each stream must be treated as an entity unto itself, that findings in one stream are not necessarily valid for all others.

The problem of toxicity in the pulp and paper industry is not as great as it is in some other industries. Bioassay methods, however, are helpful in determining the character of certain wastes and what will happen to the stream environment when those wastes are added to it. Hart, et al. (125) and Doudoroff, et al. (126) have formalized the procedures which seem best suited to conduct toxicity investigations.

The uses of the biological method can be summarized by stating that (1) the method is not intended to replace but rather to supplement other types of measurement, such as chemical; (2) biological observations are often useful in providing a better idea of what the history of pollution of a stream has been over extended periods, and (3) a remedial measure, to be useful, must result in stream improvement, and that this improvement in the last analysis can be measured most effectively the biological method.

Hedgepeth (127) has presented a general point of view. He said, "the base from which stream pollution is viewed has broadened considerably. This has brought technical groups into the picture other than biologists and sanitary engineers. These new groups are not impressed by the dogmas and sacred cows of sanitary engineers trained and experienced in water and sewage treatment. No universal measure of stream pollution is recognized. The indiscriminate use of so-called standard methods for chlorine demand and 20° B.O.D. are selected as examples of deficient methods of predicting the effect of an industrial waste on a stream. He voices strong objections of half-truth tactics. The need for a workable regulatory philosophy is expressed because some measure of stream pollution due to industry will always be present. Arbitrary adherence to a code of performance and past practice should be secondary to the facts in each case."[1]

Hoak (128) agrees in principle with Hedgepeth and says, "Our knowledge of the specific effects on stream ecology of most materials regarded as pollutants is rather meager, and the data we have is limited to fairly definite conditions. For this reason it seems illogical and uneconomical to set arbitrary limits for

[1] Quoted from an abstract by W. K. Eglof in "Public Health Engineering Abstracts" 32, No. 12: 15.

various constituents of plant effluents where knowledge of their effects is lacking. Such requirements are somewhat more defensible if they relate to the concentration of a given waste component after thorough dispersion in the receiving water."

Hoak felt that certain of the physical and chemical factors affect acquatic life might be combined to provide a broad index of stream conditions. He suggested that, if temperature, hydrogen-ion concentration dissolved solids, dissolved oxygen, turbidity, color, stream stage and effluent discharge were continuously recorded, the data might be more significant than those from the use of current methods. He pointed out that devices for measuring all of these factors, excepting turbidity and color, are available.

Summary

In the order of their importance the three problems in stream improvement facing the pulp and paper industry are (1) maintaining an adequate oxygen balance in the receiving water; (2) reducing to a practical minimum the loss of inert solids, and (3) the elimination of toxic materials from waste waters. Of these three, the first two are of much greater importance.

The approaches to the problem of the major pulping segments of the industry have been reviewed. For the most part these are related to the problem of oxygen balance. The work in reducing fiber loss and the amount of potentially toxic wastes has also been discussed.

From this discussion it is apparent that the pulp and paper industry has done many things, and has done them well, to solve its problem in stream improvement. Much remains to be done, however, and the industry is doing it on a rational and vigorous basis.

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A STATEMENT TO SUPPLEMENT THE ARTICLE "PROGRESS IN STREAM IMPROVEMENT," BY WILLIS M. VAN HORN

At the time I appeared before the U.S. Senate Select Committee on National Water Resources in Detroit on October 29, 1959, I furnished the committee with an article I had published in 1953, containing information about pollution abatement efforts in the pulp and paper industry.

The purpose of this statement is to advise the committee that in the area of semichemical pulping over the past 7 years the industry has devised several methods of recovering semichemical spent liquor on a commercial scale. The method is similar in principle to that employed by the sulfate industry, and consists of evaporating the liquor and burning it in a recovery furnace. The costs of such plants is upward of $1,500,000.

Many such plants are in operation as of today, and more are being built each year. As far as the pollution of streams is concerned, these plants utilize the spent semichemical liquor so that it is no longer sent to the river.

In the Lake States area such plants are to be found in Filer City, Mich., Watervliet, Mich., Tomahawk, Wis., and Wisconsin Rapids, Wis.

Senator HART. I did not realize when we heard from Russell Hill that there was represented also a spokesman for Lloyd Russek, who is the president of the Michigan Association of Soil Conservation

Districts. I understand that Robert Link is present. I am glad I said a kind word when I did not know you were here. We will be glad to have you make such statement as you think Mr. Russek would make if he were here.

STATEMENT OF ROBERT LINK, REPRESENTING LLOYD RUSSEK, PRESIDENT, MICHIGAN ASSOCIATION OF SOIL CONSERVATION DISTRICTS

Mr. LINK. Thank you, Senator. I am of course, pinchhitting for Lloyd and for the chairman of our State water committee. I am sorry, but I have no prepared statement to give the committee. But I do have this brief oral statement that I would like to make, briefly, outlining the general policy of the Michigan Soil Conservation Districts in regard to water problems.

I am, I might mention, Senator, very gratified by your kind remarks concerning soil conservation districts; the 33,000 members of the districts are proud of our organization and of the job we are doing.

Senator HART. You have reason to be, I agree.

Mr. LINK. And we are certainly gratified when folks recognize what we are trying to do.

Now, the problems of water have been very amply reviewed here today. So I would like to give to you a little thinking that districts have in regard to two problems which we think require emphasis.

First, soil conservation districts feel that there should be a definition of water rights, through water rights legislation. We feel, of course, that this is primarily——

Senator HART. You are talking about State legislation?

Mr. LINK. Yes; we feel this is a State responsibility.

The farmers, of course, just like everyone else are having increasing demand on water. This has been mentioned a couple of times today, but maybe not emphasized as much as we would like to have it.

Agriculture is, although the number of farmers in Michigan are decreasing, we feel that our segment of the economy is still pretty important to the State. Michigan still ranks among the top 10 States in a wide range of commodities, namely, dairy, soft white wheat, fruits, and vegetables; and in these areas Michigan is important productionwise.

Senator HART. Do you not want to use this as a sounding board to make the point right in the middle of the big city that soft white wheat is not the stuff that is going into the deep bins and producing so much surplus? I know it has nothing to do with this hearing but I would like to make it.

Mr. LINK. That is right; last year all of Michigan's soft white wheat went on the market and was consumed. The seaway has also helped in this respect. It made our wheat more available to foreign buyers, and they like it.

Now, I would like to emphasize that even though soil conservation districts are pressing for water rights legislation, and we feel that people who are going to irrigate and use water for other things need to have their rights defined and they should be defined in the near fu-

ture. But we are not interested in protection of our water rights at the expense of other groups.

The proper type of control law must recognize the needs of all groups—agriculture, recreation, wild life, municipalities, and industry.

Now, we feel that only when control law properly protects all segments of the economy is it acceptable to us or to anyone else.

Now, the second area we would like to emphasize is that water rights laws are going to mean very little unless immediate action is taken to step up protection of the quality of ground water, water in our lakes and streams and stream channels. This has been discussed at length. However, little has been said about the relation of agriculture to this problem.

Mr. Wightman and Russell Hill and some of the other folks have mentioned it, and I would like to emphasize this again: We feel that this is a joint problem of private interest, local, State, and Federal Governments.

Conservation, we feel, is sort of a public responsibility. Now these problems, and I am not going to recount them, as they have been mentioned many times today, we feel, too, should be approached on the watershed basis with restoration in some cases and enlargement of the stream channel with the elimination of sources of silt and contamination.

Now, the key to the success of this development, again, we feel, is the proper land treatment and control of water in the upper reaches of the watershed. This is where the rain falls, and Mr. Hill mentioned it this afternoon. This calls for special work and special treatment, works of improvement, erosion control structures, reforestation, to sod waterways, and the type of erosion control and land treatment that farmers can accomplish on their land.

Now, many of these works of improvement are the type of thing that actually does not profit the individual farmer to any great extent. In other words, incomewise, whether he does it or whether he does not do it, may not make much difference to him in his lifetime, which makes it sort of a public responsibility; if he spends his money to do these things, perhaps he is entitled to some assistance.

Now, farmer members of soil conservation districts have been greatly assisted by the Soil Conservation Service, the Forest Service and the agricultural conservation program which is a cost-sharing program.

In this way they have done a great deal, but it is only a fraction of the work that needs to be done.

Local people should and in most cases are willing to accept basic responsibility for getting this work done. I may be extending myself a little bit. I will grant you that some, the members of even our soil conservation districts, could stand a little more education in the needs of soil and water conservation.

But by and large we think they are beginning to accept this responsibility, the basic responsibility.

However, they are still going to need the technical and financial assistance of State and Federal Governments. This is where the small watershed law comes in and we are much interested in Public Law 566. We think it is a real help. However, we think it may have

some limitations, but with experience and frequent review we hope that the law can be improved to act more swiftly because people when they start dealing with these problems become impatient. Perhaps 566 can in the near future be improved so that it can handle the needs more complete.

I thank you.

Senator HART. Thank you very much.

I was inquiring of the staff director, Mr. Schad, whether my recollection was right on this and I think it is, that your interest and suggestion is that Public Law 566 be changed if it can be changed for the better.

Mr. LINK. That is right.

Senator HART. Let's put it that way. It is very definitely shared. It is an area of real concern to the chairman of this committee. I know that.

Again thank you.

Is there a spokesman from the Huron River Watershed Intergovernmental Committee here?

STATEMENT OF WILLIAM GABLE, INSTITUTE OF PUBLIC ADMINISTRATION, UNIVERSITY OF MICHIGAN

Mr. GABLE. Senator Hart, I am William Gable, research assistant, Institute of Public Administration, University of Michigan.

Mr. Scheel was unable to be here this afternoon and requested that I make a presentation to your committee, if I might, and read into the record the copies which I have distributed to your staff.

The Huron River watershed to us typifies many of the smaller river basins in this country which fall immediately about or adjacent to some of our metropolitan areas. We feel that it indicates a problem area that has not been touched upon particularly by the Federal Government in its relations with the States and the development of water resources.

For example, we have 900 square miles in the southeastern region of Michigan adjacent to the Detroit metropolitan area which has grown second only to the Los Angeles-San Francisco area in rate of growth, that is, 28-percent growth as opposed to 35-percent growth since 1950. We have 225,000 people living in the Huron River watershed at this time and we anticipate some 500,000 people to be living in this watershed by 1980.

At the present time we are using this river for domestic water supplies, waste disposal, agriculture irrigation, and to a lesser degree hydroelectric power generation at the present time. By 1980 if the demand upon the river continues at the rate they are at present we very likely will not have a river so we have to think ahead into the future.

This population growth, this urban expansion, this urban sprawl referred to and I have seen it referred to all over our country is so great that we have actually had to stop building in certain areas along the river.

The health department has seen the pollution as being so grave that they have had to hold up the granting of additional permits to build

and the additional location of industries because we do not have sufficient treatment facilities available at the present time.

On top if this we have 50,000 acres of public recreation land along the Huron in this part of our State. We have many other features which are beginning to change.

The fact that agriculture at the present time is beginning to use more and more water for irrigation purposes, and we see a change in type of agriculture along the river, so that with these problems developing the Huron River Watershed Intergovernmental Committee was formed by some 32 different governmental units in the Huron River Basin.

Four counties, 20 townships, 4 cities, and 4 villages got together under a unique act which we think very important in Michigan, that is, act 200 of the Public Acts of 1957, which allows for inner-municipal and intergovernmental planning and programing of various water resources and other governmental services. These 32 units of Government got together, and they said the best thing we can do is to make a comprehensive study of an entire water basin and particularly a small water basin.

We contemplated at that time development of a ground-water study which we were able to receive assistance from by a member of the geology department of the University of Michigan and an irrigation study.

Again I would like to back up our last speaker here from the Soil Conservation Service. Under the provisions of section 6 of Federal Public Act 566, they came to our assistance in the programing of our research for this watershed. We understand that this is one of the few cases where this specific section of the Watershed Protection and Flood Prevention Act has been used in cooperation with local groups such as our committee.

We would like to testify to the value of this type of technical assistance in encouraging local initiative and to express our gratitude to the Department of Agriculture for the assistance they have given us in this instance.

We also programed an engineering study. Since our biggest problem is in the lower Huron area where the largest population growth has taken place and the greatest pollution problems have developed, we have undertaken an engineering study to study such problems as pollution load, effects upon recreation areas, possible solutions to the problem presented by the engineering features and the pollution problems of the river.

Now, the only problem is that we have contemplated a comprehensive package of research. We also feel that after we look at the ground-water supply, the irrigation problems, and the engineering aspects of the river that we need to get together administratively and financially to program a future pattern of operation within this area.

But this is where we have run into severe difficulties in raising the necessary research funds in order to develop a properly planned and organized program.

So we have two or three suggestions we feel specifically will aid all of the small river watersheds, particularly in the metropolitan area. Some of the possible areas for Federal assistance we think might be in the area of planning.

First, financial assistance. The watershed area is not coterminous with any established taxing or other revenue collecting organization; and the communities lying within the basin are faced with problems new to them, some of which are vaguely conceived. These problems have to be faced now, but the communities involved have not been able to bring about the coordinating planning necessary for this. The committee has been hampered by lack of funds to conduct the studies it considers necessary and its current program of studies has been dictated by expediency as well as by necessity.

A source of assured funds for watershed planning purposes would enable groups such as ours to carry out comprehensive programs of studies. We have investigated the possibility of obtaining funds from the Program of Planning Advances of the Federal Housing and Home Finance Agency, but were advised that our committee did not qualify as a recipient of such funds. If planning to meet future water needs need to be done on a local level, at least in the case of small watersheds such as the Huron, Federal planning grants for established watershed organizations would be of great assistance in encouraging local units to respond to these emerging problems in ways commensurate with their importance.

A second area that we feel that the Federal assistance program might be developed is in the area of technical assistance similar to what we referred to in connection with the Soil Conservation Service.

Technical assistance in planning could be a great help. This might encompass all aspects of water use necessary to develop a program of integrated water management for a basin. The technical assistance which our committee has received from the Soil Conservation Service under the provisions of Public Law 566 has been extremely useful. However, broader technical assistance in planning than is possible under that act would be most valuable. However, we conceive of this in a broader nature in planning a total program of use within a water basin. Basinwide development seems to be a pioneering approach for small drainage basins in urban areas at present. The Federal Government has been an active participant in such programs for some of the larger river basins. In view of this, it would be helpful to have a Federal coordinating body assigned to act as a clearinghouse, providing broad-gaged technical assistance and information on organizing and conducting the planning of comprehensive water management programs for the smaller drainage basins.

Then in the area of capital improvements we have several suggestions where we feel if we could have a developing cooperation between the Federal Government and local areas yet reserving the responsibility and development planning at the local level.

If future crisis conditions due to water problems in the Huron basin are to be prevented, facilities must be constructed or provided now, before this population growth, which are in excess of the present demand. For example, if the basin's water resource base is to be expanded in the future by the construction of reservoirs, the acquisition of sites must take place very soon. It is not necessary to construct the reservoirs at present, but unless suitable sites are acquired, rapid development will make this much more difficult or impossible in the future. The construction of large, intercommunity trunkline sewers will provide a long-term solution to waste disposal problems and will

open fringe areas to residential development by providing this urban service, but such trunklines must be provided in advance, to some extent, of the ultimate need for them. Much of the population which they are designed to serve, does not yet exist in the area at the moment. These and other problems will make the financing of construction difficult. It is the old problem of getting the revenue coming in before the people are there to pay the revenue. There is a lag between the time we can pay for the facilities, yet the decisions to make them must be made before we are hit by the crisis. The committee suggests two possible ways in which Federal financial assistance might be provided.

Loans—and we accentuate this point—although areas such as ours can ultimately pay for the capital facilities required, they are faced with early financial limitations which can paralyze progress. A basic problem in the provision of large-scale facilities such as trunkline sewers in the lag from the time the decision is made to undertake construction until the facilities actually begin to operate and yield revenues. This is the most critical period from the standpoint of local government-financing ability. The length of the period will vary with the specific case involved, but it might be 2 or 3 years on the average. Low-interest rate Federal loans to cover this period, possibly made from a revolving fund, could ease considerably the financial burden on local government units.

And again I would try to emphasize the loan feature here of a revolving nature so that local government units would be able to receive money when they need it but pay it back in when the revenues start coming in. This would not be in the nature of a grant and would not other than the initial reception of this revolving fund, create a regular and overwhelming drain upon Federal financing as we see it.

Then there is one other area. Grants for nonreimbursable benefits. In many river basins, probably more so in some other than in the Huron, local initiative in water development is discouraged by the fact that benefits will accrue which would be nonreimbursable if the whole project were undertaken by the Federal Government. It would seem equitable wherever non-Federal projects yield nonreimbursable benefits such as flood control or fish and wildlife propagation, for example, to provide Federal grants to cover these benefits. A bill introduced this year by Senator Engle (S. 13, 86th Cong., 1st sess.) seemed to be seeking this objective. We are not familiar with all the provisions of that bill, but we do support this concept of Federal grants to local non-Federal water development programs for benefits which are nonreimbursable when they accrue to Federal projects.

Senator HART. Thank you very much.

Mr. GABLE. Thank you.

Senator HART. Let me introduce, before he leaves, the representative who is attending these hearings on behalf of Senator Engle who is a member of this committee but who remained in the West. Mr. Phil Dickinson who is standing there, and I am sure he will be glad to know that in Michigan Senator Engle's effort was applauded.

Mr. DICKINSON. Thank you.

(The prepared statement of the Huron River Watershed Intergovernmental Committee follows:)

HURON RIVER BASIN

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Statement of Huron River Watershed Intergovernmental Committee

(By Dr. William Gable)

INTRODUCTION

The Huron River Watershed Intergovernmental Committee is organized to study and recommend solutions to water problems within the Huron River Basin. It seems evident that the problems being encountered in our basin are ones which will be occurring more and more commonly in river basins in other metropolitan areas. For this reason we believe our experiences with problems in the Huron Basin are of significance to the considerations of the Senate Select Committee on National Water Resources.

The Huron River drains a 900-square-mile watershed in southeastern Michigan. The basin's water resources are used for municipal and domestic supplies, waste disposal, recreation, and to a lesser extent, for irrigation and hydroelectric power generation. The basin lies on the fringe of the rapidly expanding Detroit metropolitan area and is experiencing water problems as a result of population growth and urbanization. The present population of the basin is approximately 225,000, and it is expected that this may approach 500,000 by about 1980.

The basin's situation with respect to the expanding metropolitan area makes it both a special case and yet, at the same time, typical. It is a special case in the sense that it presents problems of water management which we feel current Federal water policy does not consider. It is representative in the sense that, as the metropolitan centers of the country expand to engulf satellite towns and villages and intensity of water use and conflicts increase, problems such as we are experiencing will become common on many river systems, both large and small, in the eastern United States.

There are feasible technical solutions to many of these problems but such solutions are dependent upon an organization to do research, to plan and to implement them. This seems to be the crux of the problem in situations such as ours. Although the need for water management is increasing in rapidly urbanizing small river basins, the know-how and funds necessary to organize and develop such programs are not readily available.

BACKGROUND TO HURON RIVER PROBLEMS

At present, population concentration and growth are greatest in the lower portion of the Huron River Basin and water problems are the most pressing there. From Ann Arbor downstream, these problems center around the provision of water supply, sewage disposal, and recreational services in rapidly growing urban areas and around the equitable use of the river to serve these needs. The problems stem from the fact that water is no respecter of political boundaries. The river flows through a multiplicity of local government units in the area, each wanting to use the river for its own purposes. In addition to the problems of providing water services in a metropolitan area, there are problems of basinwide water management involved, reaching into rural areas well removed from the metropolitan complex.

It is recognition of this situation that has led the Michigan Department of Health to withhold permission to expand or construct new municipal and industrial sewage treatment facilities adjacent to the lower Huron River during the last 2 years. The delay in issuance of permits for expanding treatment facilities has caused considerable difficulty to several communities and industries. In one case, for example, a subdivider who wanted to build over 400 homes in Ypsilanti Township was refused permission to proceed because of the inability of the township to guarantee provision of sewage disposal facilities. The department of health's position has been that all communities and industries in the lower Huron Basin should join together in an effort to define the limitations, both present and future, to the uses that can be made of the river. They have stated that what is needed is an overall and areawide study of the capacities of the river for sustaining the rapidly increasing demands being made on it.

Water problems are not yet so acute in the upper portion of the basin, but they do exist, and they will become more serious as population pressures and water use become more intensive. The withdrawal of water for supplemental irrigation, for example, is increasing rapidly. Unless this is controlled in the future, it could have adverse effects on the adequacy of streamflow for other water uses

downstream. The basin is an important recreational area, containing about two-thirds of the regional recreation lands in southeastern Michigan. There are about 50,000 acres of public recreation lands with some stream or lake frontage in the basin. There are many lakes in the upper portions of the basin and more and more conflicts are arising between public recreation and private residential use there. Uncontrolled residential development around many of the lakes has led to the creation of lakefront slums, with public health and flood damage problems.

It has become increasingly apparent that there are two major aspects to the basin's water problems. One is the governmental problem of providing services in metropolitan areas which overlap a number of local governmental units, a problem which is commonly encountered in the provision of urban services not associated with water, such as police protection or garbage disposal. The other is the need to consider the basin as a physical entity and to develop a basinwide water management program. In the past few years there has been growing recognition that some cooperative approach toward solving these problems should be made, and that this should be on a watershed basis.

THE HURON RIVER WATERSHED INTERGOVERNMENTAL COMMITTEE

Fortunately, we have in Michigan an act which enables the creation by two or more municipalities, of an intermunicipality committee for the purpose of studying area problems (Act 200 of the Public Acts of 1957 of the State of Michigan). In April 1958, 32 local governmental units (4 counties, 20 townships, 4 cities and 4 villages) utilized the provisions of this act and joined to form the Huron River Watershed Intergovernmental Committee. The committee's objective is to sponsor studies of problems of mutual concern to member government bodies in regard to water management and related land uses in the Huron watershed. It has the power to study problems and recommend solutions, but no power to construct or operate facilities. The committee's routine operations have been financed by initial contributions from the member communities assessed on a per capita basis. The Washtenaw County Planning Commission has provided staff. The committee appointed a technical advisory subcommittee comprised of engineers, planners, and university professors to recommend and outline the studies which should be undertaken.

STUDIES UNDER WAY

The committee's ultimate objective is to determine the present and potential water development and management possibilities as they relate to the development of a desirable and feasible pattern of land use for the basin. The actual studies now sponsored by the committee, are directed toward the long-range objective. Actually, however, they represent those studies which the committee has found feasible to implement, rather than the most orderly progression toward the long-range objective.

1. Ground water study

The committee has given a small grant to the University of Michigan Geology Department to support a study of ground water resources in the Huron Basin. This study will take approximately 2 years and will include the following:

(*a*) Evaluation of past and present uses of ground water.
(*b*) Compilation of all existing well logs.
(*c*) Evaluation of all ground water aquifers now being used.
(*d*) Recommendations for new areas which have a potential of yielding ground water supplies.
(*e*) Relationship of ground water to surface water in the Huron River watershed.

It is anticipated that the results will be a valuable aid in planning to meet future domestic and industrial water supply needs within the basin.

2. Irrigation study

With greatly increased population projected, agriculture will have to become more competitive with urban land uses to remain in the basin. There is good evidence to indicate that there will be a trend from extensive agriculture to intensive truck cropping in the next 25 years. This will mean increased irrigation. Planning will be needed to avoid future conflicts between agricultural interests and downstream water uses.

A study of agricultural water use within the basin is being made at the request of the committee by the Soil Conservation Service under the provisions of section 6, Federal Public Law 566. We understand that this is one of the few cases where this specific section of the Watershed Protection and Flood Prevention Act has been used in cooperation with a local group such as our committee. We would like to testify to the value of this kind of technical assistance in encouraging local initiative, and to express our gratitude to the Department of Agriculture for the assistance it has given us.

This study is now almost completed and it will provide us with information on the area of land likely to be irrigated in the next 25 years and quantities of water which will be needed to provide for such irrigation.

3. Lower Huron engineering study

The problem of sewage dispoal in the lower basin has been so pressing that it has received the largest part of the committee's interest and attention. On the recommendation of the technical advisory subcommittee, a firm of consulting engineers was hired to develop a long-range area plan for waste disposal in this area. The cost of the study was $30,000. This has been raised by subscription from eight communities discharging wastes in the lower Huron area, several other local government organizations, and a public utility company.

The engineering study is almost completed, and tentatively, its recommendations will involve the construction of trunkline sewers to carry wastes out of the basin to the Wayne County disposal system for ultimate discharge, after treatment, to the Detroit River. The scheme will be sequenced, so by about 1980, the major sources of pollution would no longer discharge wastes to the river.

Two major factors underlie the engineers' recommendation to eliminate waste disposal as one of the uses of the Huron River. One is the enormous expansion expected to occur within the basin in the coming decades. The other is the investment in recreational lands in the Huron Basin. The park lands in the lower Huron area are important recreational assets which will become more and more valuable as the population increases. The data available indicate that the population is not at present exceeding the capacity of the stream to absorb and naturally purify the waste discharged to it. At the same time it is clear that, with population growth, eventually even well-treated sewage effluents would contain enough residual waste materials to overwhelm the self-purification capacity of the stream. The pollutional conditions created would then destroy the river as a recreational and environmental asset.

The discharge of the lower Huron area's wastes to the Wayne County system would obviously involve diversion of large quantities of water from the Huron River. During certain drought years, when this diversion would need to be compensated for, the flow could be kept at a satisfactory level by the construction of storage reservoirs in the upper drainage basin. The reservoirs would be used to store peak flows and to release these to augment the flows in the lower Huron during the dry summer months. Such release would have to take place only during especially dry years, perhaps 1 out of every 10 years. The other times, the levels in the reservoirs could be kept up and they would be available for recreation. There would be other possible benefits, too, in flood control, water supply, and provision for fish and other wildlife habitat. The engineers pointed out that there would be no need to construct these reservoirs for some years yet, until diversion of water from the lower Huron was great enough to seriously affect low stream flows. However, these, or other suitable reservoir sites should be obtained as soon as possible before they are occupied by subdivisions and superhighways and become unavailable.

The basin's ground and surface water supplies will probably not be great enough to meet future domestic and industrial water supply needs, at least, not without construction of much larger-scale storage reservoirs than is contemplated. At such time as the demands exceed the supply within the basin, perhaps by about 1980, it is expected that portions of the basin will be served by the Detroit water system. That system, with virtually unlimited supplies from the Great Lakes, plans to be the supplier for much of southeastern Michigan. In this respect the Huron River Basin may not be typical of some other areas in which provision of adequate water supplies will be a major and limiting consideration. On the other hand, our case does show that water problems in metropolitan areas can be serious and difficult, even where adequate water supplies are available to meet long-range future needs.

PROBLEMS IN THE COMMITTEE'S PROGRAM

This committee has encountered a number of difficulties in working toward its objectives. These seem due to the fact that the Huron basin is just entering a phase where coordinated water management is necessary, because of increased population and intensity of use. Local governmental units in the basin have shown considerable initiative in joining to form the committee and in contributing to studies now underway. However, the concept of a need for cooperation to develop a water management program is relatively new in this area and there is still a long way to go. In this respect, the committee's experience may be typical of difficulties to be encountered in other eastern watersheds where the effects of rapid urbanization and water use conflicts are being felt.

The problems that the committee has encountered center around the difficulty in raising funds to provide solutions for problems which are so foreign to the experience of local governments and which are still largely future, rather than immediate ones. In the case of the lower Huron engineering study, the Michigan Department of Health's refusal to allow expansion of waste disposal facilities has made the problem an urgent one and the communities involved have organized and financed a cooperative study. In the case of other problems which are potentially as great, but less immediate, and therefore less apparent, active participation has been more difficult to obtain.

This can be best illustrated by a discussion of two studies which the committee feels are necessary to achieve its objectives, but which it has been unable to undertake because of lack of funds.

1. Administrative-finance study

The findings of the engineering study indicate that the long-range solution to waste disposal problems in the lower Huron area will involve a program of water management requiring intergovernmental cooperation. The questions of how intercepting sewers would be financed, of who would construct and operate the recommended reservoirs, of how costs would be allocated and many others would have to be answered before such a program could be implemented. Our approach to this problem was to design an administrative-finance study to give advance consideration to these questions. However, in spite of the opportunity to obtain such a study at cost from the University of Michigan, we have been unable to raise the necessary funds. In fact, some industrial leaders in this area, when solicited for support, acknowledged the importance, but took the position that our studies should be supported entirely by tax funds. The local units of government, on the other hand, feel that they have already contributed their fair share to the committee's program.

It now appears that financial and organizational solutions may have to be worked out by the communities involved on the most expedient basis. This, in turn, may lead to the most expedient, rather than most desirable, water management program being adopted.

2. Planning study

In order to accomplish its long-range objectives, the committee should undertake a planning study which would determine the developmental limitations of the basin's land and water resources. Such a study could be integrated with the studies of established planning organizations such as regional and county planning commissions, which encompass portions of the basin, to develop a recommended pattern of land uses for the basin together with recommendations as to how this could be implemented. The study has not yet been designed, as no sources of funds for this are in sight at the present.

POSSIBLE AREAS FOR FEDERAL ASSISTANCE

The committee sees two general areas in which Federal assistance could best help accomplish the objective of solving water problems and providing for future needs in the Huron and other similar river basins.

1. Planning

(*a*) *Financial assistance.*—The watershed area is not coterminous with any established taxing or other revenue collecting organization; and the communities lying within the basin are faced with problems new to them, some of which are vaguely conceived. These problems have to be faced now, but the communities involved have not been able to bring about the coordinating planning necessary for this. The committee has been hampered by lack of funds to

conduct the studies it considers necessary and its current program of studies has been dictated by expediency as well as by necessity.

A source of assured funds for watershed planning purposes would enable groups such as ours to carry out comprehensive programs of studies. We have investigated the possibility of obtaining funds from the program of planning advances of the Federal Housing and Home Finance Agency, but were advised that our committee did not qualify as a recipient of such funds. If planning to meet future water needs is to be done on a local level, at least in the case of small watersheds such as the Huron, Federal planning grants for established watershed organizations would be of great assistance in encouraging local units to respond to these emerging problems in ways commensurate with their importance.

(*b*) *Technical assistance.*—Similarly, technical assistance in planning could be a great help. This might encompass all aspects of water use necessary to develop a program of integrated water management for a basin. The technical assistance which our committee has received from the Soil Conservation Service under the provisions of Public Law 566 has been extremely useful. However, broader technical assistance in planning than is possible under that act would be most valuable. Basinwide planning and development seems to be a pioneering approach for small drainage basins in urban areas at present. The Federal Government has been an active participant in such programs for some of the larger river basins. In view of this, it would be helpful to have a Federal coordinating body assigned to act as a clearinghouse, providing broad gaged technical assistance and information on organizing and conducting the planning of comprehensive water management programs for the smaller drainage basins.

2. Capital improvements

If future crisis conditions due to water problems in the Huron Basin are to be prevented, facilities must be constructed or provided now, which are in excess of the present demand. For example, if the basin's water resource base is to be expanded in the future by the construction of reservoirs, the acquisition of sites must take place very soon. It is not necessary to construct the reservoirs at present, but unless suitable sites are acquired, rapid development will make this much more difficult or impossible. The construction of large, intercommunity trunkline sewers will provide a long term solution to waste disposal problems and will open fringe areas to residential development by providing this urban service, but such trunklines must be provided in advance, to some extent, of the ultimate need for them. Much of the population which they are designed to serve, does not yet exist in the area. These and other problems will make the financing of construction difficult. The committee suggests two possible ways in which Federal financial assistance might be provided.

(*a*) *Loans.*—Although areas such as ours can ultimately pay for the capital facilities required, they are faced with early financial limitations which can paralyze progress. A basic problem in the provision of large-scale facilities such as trunkline sewers is the lag from the time the decision is made to undertake construction until the facilities actually begin to operate and yield revenues. This is the most critical period from the standpoint of local government financing ability. The length of the period will vary with the specific case involved, but it might be 2 or 3 years on the average. Low-interest rate Federal loans to cover this period, possibly made from a revolving fund, could ease considerably the financial burden on local government units.

(*b*) *Grants for nonreimbursable benefits.*—In many river basins, probably more so in some others than in the Huron, local initiative in water development is discouraged by the fact that benefits will accrue which would be nonreimbursable if the whole project were undertaken by the Federal Government. It would seem equitable wherever non-Federal projects yield nonreimbursable benefits such as flood control or fish and wildlife propogation, for example, to provide Federal grants to cover these benefits. A bill introduced this year by Senator Engle (5.13, 86th Cong., 1st sess.) seemed to be seeking this objective. We are not familiar with all the provisions of that bill, but we do support this concept of Federal grants to local non-Federal water development programs for benefits which are nonreimbursable when they accrue to Federal projects.

Senator HART. At the request of Congressman James O'Hara of the Michigan Seventh Congressional District, the city of Port Huron

is to be heard. I will ask the Congressman to introduce the distinguished Mayor.

Representative O'HARA. Senator, we have heard testimony today showing that in the Great Lakes Basin it is the quality of our water resources more than the quantity that is the problem. We have heard evidence suggesting that improper treatment of waste has caused a serious problem with regard to quality.

I have discovered as you have in the last few months, that our rapidly expanding technological society is constantly creating new problems of water pollution, and I have therefore asked the mayor of the city of Port Huron, Mr. Robert Patterson, to tell the committee about one such problem in the Great Lakes area which I believe constitutes a very great threat to the purity of the fine water resources we do have.

STATEMENT OF ROBERT L. PATTERSON, MAYOR OF PORT HURON, MICH.

Mayor PATTERSON. Thank you, Congressman O'Hara.

Mr. Chairman, I am representing not only the city of Port Huron, but also all the cities from the headwaters of the St. Clair River down to the Detroit area. I would also like to add I am a vice chairman of the Canadian-American Committee on Water Pollution.

The State of Michigan receives innumerable benefits from its strategic location on the Great Lakes. However, we are threatened with a very serious water pollution problem which must be solved through the joint efforts of the United States and Canadian Governments.

We are very concerned about the proposed drilling of oil wells in the southern end of Lake Huron.

Experience with recent drilling in Lake Erie and other places shows that pollution of the surrounding area water and beaches occurs through leakage, even with the best of engineering precautions. The proposed drilling in Lake Huron presents a grave danger to the fresh water supply of Port Huron and other cities, both Canadian and American, on the St. Clair River. In addition, the cities of Detroit and Flint have already formulated plans to construct intake plants to draw water from Lake Huron. Therefore, we are faced with the contamination of the water supply for an area which now contains about 5 million people and which is designated by planning authorities as one of the fastest growing areas in the entire Nation.

Oil seeping from wells in Lake Huron will also blanket the several miles of excellent beaches in our community thereby damaging another of our God-given natural resources.

Our manufacturing and fishing industry will also suffer and our potential industrial development will be seriously handicapped as our unlimited supply of fresh water is one of our biggest assets in attracting new industries.

In considering this matter, it is well to keep in mind that the Great Lakes contain one-sixth of the world's supply of fresh water, whereas the oil under these lakes constitutes only a meager fraction of the world's supply of oil. Seeing this problem in its proper perspective shows clearly the relative importance of our water and demonstrates the need for the protection of this great natural resource.

We would also like to point out that great progress in the elimination of pollution has recently been made in this area through the expenditure of millions of dollars for sewage disposal plants in both Canada and the United States. Surely we cannot afford to lose ground by introducing a new source of pollution at this time.

The proposed drilling in Lake Huron is in Canadian waters and we have worked closely with our neighbors in Sarnia, Ontario, in combatting this common problem. Inasmuch as this is a problem common to both the United States and Canada, we ask that the Congress of the United States consider this matter and pass the necessary Federal legislation in joint cooperation with the Canadian Government, in order that the beauty and utility of our Great Lakes may be preserved.

Senator Hart, may I say in conclusion, that it was through your efforts and also the efforts of Congressman O'Hara from the Seventh Congressional District of Michigan, which prevented the drilling of oil in Lake Huron this past summer and fall. However, we do believe that drilling will resume in the early spring of 1960 unless Federal legislation in joint cooperation with the Canadian delegation will help us prevent this.

Senator HART. You are very complimentary, Mayor, but the truth is the first voice to be heard and the one that reached us the quickest was your own. If there is any slowing down of that operation you can put your name at the top of that list. Maybe this is not a question that fairly should be addresed to you, but it is one that is raised by a comment you make here.

Periodically, we read that a Michigan municipality is planning to construct intake plants to draw water out of Huron or Michigan. You specifically mentioned the occasional indication of interest in Flint and Detroit and some from Oakland County. I know Pontiac occasionally raises this question of taking it out of Lake Huron.

Would the construction of that sort of intake plant require agreement of the Dominion Government?

Mayor PATTERSON. No, sir; I do not believe so.

Senator HART. You do not think so.

It never occurred to me until I heard that Chicago diversion debate this spring. But if it would affect the level of the lake, I was just wondering whether the fact that it was our lake, at least we think so, made any difference. I would suspect that Canada might have a different attitude on it.

Thank you very much for this. I hope we can face up to this business of potential oil pollution across the border.

Mayor PATTERSON. Thank you, Senator Hart.

Senator HART. Maybe if we can do that you can bargain with Sarnia to reduce that outflow from their chemical vaporizer.

Mayor PATTERSON. That will be a good target.

Senator HART. I should have earlier introduced Leo Urcala who is here for the Bureau of Commercial Fisheries. His office is in Ann Arbor. I am sorry that I did not ask him to rise before. But there he is.

Mr. Tyrone Gillespie from Dow Chemical.

We have invited the Dow Chemical Co., and I think Mr. Gillespie is accompanied by Mr. Powers, am I right on that?

STATEMENT OF TYRONE GILLESPIE, ASSISTANT TO THE PRESIDENT, THE DOW CHEMICAL CO.

Mr. GILLESPIE. Yes, sir.

Senator Hart, I think you will be pleased to know through a breakup in the mails and someway we did not receive this invitation until early this week, so you are indeed fortunate we did not have time to write a book for you, to read to you today.

I am Tyrone Gillespie, assistant to the president of the Dow Chemical Co., with headquarters in Midland, Mich.

Mr. Macauley Whiting, assistant general manager of our Midland division, is with me today. He has particular knowledge and concern on the subject of power and cooling water and navigational projects under study by our company.

Mr. Thomas J. Powers, manager of waste control and water utilization for the Dow Chemical Co., and who was a member of the President's Advisory Board on Water Pollution Control, is also with me today to discuss the statement of our company to this committee, and answer any questions the committee may see fit to address to him.

May we say that we are sympathetic with the tremendous task with which this committee is faced.

We are mindful that the committee has many serious problems to consider, among which are competition for water resources, jurisdiction of management of water resources, public and private power questions, industrial versus recreational uses, pollution and waste disposal, flood control, soil erosion, irrigation, and navigation. These must be solved, for water is a most important national resource.

Dow is a major industrial user. In Michigan we use about 250 million gallons of water a day, and in Texas we use 1,440 million gallons of sea water per day and 50 million gallons of fresh water. I might interject in here, when we say use, that does not mean it is consumed. Ninety percent of this water is returned to the streams. We as a company are confronted with some of the same problems that concern this committee, though on a smaller scale, and we are happy to share with you whatever knowledge and experience that we have acquired, which may be helpful.

It is our belief that the water use of the State of Michigan is about 135 to 140 gallons per capita per day for domestic use, and that present population is about 8 million people. This is a present use of over 1 billion gallons a day, and the population of Michigan is increasing at the rate of 2.5 percent per year.

The use of water for industry could well be five times the amount used by domestic users. Figures seem to indicate that industrial uses of water increase about 100 percent over a decade, and public use about 40 percent. As a rule of thumb, in the chemical industry alone we will use about 1 gallon of water per day for $1 of investment.

We feel that industry should participate in the development of water conservation techniques and resources, for its own use, and not place this duty solely on public authority. We believe that such a position is equitable and possible.

It would seem that if those who derive the principal benefit are unwilling to share a major burden of the cost, there can be some doubt as to the real need for a particular water development. This posi-

tion, however, is likely to encourage industry to concentrate in areas where water can be had a minimum expense.

We are great believers of do-it-yourself up in Midland, so we would like to tell the committee some of the things that we have done for ourselves.

We have spent in the range of $5 million in Michigan to build settling ponds and waste treatment plants to clean up plant effluent before returning it to the streams, so that there will be no pollution of waterways resultant from our operations.

I think a sidelight on that that would interest the committee is this: We developed in Midland a bacteria which will have the possibility of eating phenol. It thrives on phenol waste. It is the only thing in the world that we know will. So we feed the phenol waste to this bacteria. This was a development that we were able to participate in.

We have created some 24 disposal wells where we are able to discharge 160 million gallons per month of water containing wastes without injury either to streams or to land or water surrounding the disposal wells.

We have been active in the promotion of, and have contributed to, by way of contract, the development of watershed on the Tittabawassee River Basin, and we are studying further possibilities in this regard. May we say that we have worked with the U.S. Army Engineers in a study of flood potential and the structures necessary to contain floods on the Tittabawassee River where we do have flooding conditions nearly every spring. But though we have cooperated with the Engineers, we feel rather positively that a better answer to the problem is watershed development and ponding upstream, and we subscribe heartily to the philosophy of the U.S. Soil Conservation Service to retain the water where it falls. We are actively studying some possibilities in this regard. It just seems to make sense rather than building dams and dikes around your town to keep them from flooding that you would find a way to control your water upstream and make it usable rather than have it rush by you.

We have participated actively in the development of fresh water supply from Whitestone Point in Lake Huron, which is the water supply for Saginaw and Midland. Actually, a line into our company plant in Midland delivers up to 10 million gallons a day, and a like amount is used by the city of Midland. Without our contract this important development could not have been made.

The company has a a strong interest in the development of waterways for navigation. There should be grave consideration given to keeping up the water levels in the Great Lakes, and the programs to do that, and the channels should be kept open so that the St. Lawrence Seaway navigational programs can be realized. We have done extensive study on a Saginaw River-Tittabawassee River barge canal. This canal, if it becomes a reality, would create an industrial center in the middle of our State which could redound greatly to the benefit of the State of Michigan's ambitions for progress.

The saline water project sponsored by the U.S. Government at Freeport, Tex., that is the making of fresh water from sea water, is supported by our company with contracts which furnish facilities to the contractor and which will buy and use the water produced.

A very interesting thing is the project Ploughshare which is under study by the Government and Livermore Laboratories, which orig-

inated with a Dow scientist. The Government prepared and presented a movie on this project at Geneva during the International Conference on Atomic Energy. Briefly, this idea is the creation of large aquifers by hydrogen explosions beneath the earth in arid and semiarid areas. These aquifers would catch the rainfall and hold it, instead of allowing the water to escape in flash floods, thus restoring lands and replenishing water tables which are disappearing or have disappeared. This same scientist, Dr. John Grebe, is supporting the idea of deep plowing—to the depth of 3 or 4 feet—as a conservation measure, for such plowing will hold water that shallow plowing will not.

He also advocates the creation of small aquifers at a depth of, say, 300 to 400 feet, created by a "humping shot" of explosives. This is a possibility for retention of much water without disturbing the land seriously. These are the ideas of one scientist, which have not been demonstrated, but they are indicative that there are still areas to be explored and researched in this program of water conservation.

As its most recent contribution, our company has set up an industrial service division which will contract with industrial concerns to create systems of waste disposal and to tackle problems of industrial pollution. I might add that Dow was also the company that produced a chemical called Dowlaf which has been the effective weapon against the sea lamprey in the Great Lakes.

There will be other things which the company can and will do, based on its store of technical knowledge and its great interest in water resources and their conservation. For instance, it is not hard to envision the development of a plastic which would be extremely cheap but is suitable for making reservoirs, and to use this same plastic in making irrigation pipe, so you do not have the loss you have in running ditches. Perhaps a plastic which we have today could be made in quantities and adapted to such purposes.

All of these illustrations of the ideas and efforts of our company in the realm of water resource have led us to some conclusions which we put forward as our philosophy on water, its use, and conservation.

The Nation and our State (which has been peculiarly blessed with water) must become increasingly conscious of the necessity for maximum development of sources of water to serve its people, to expand its industry, to provide recreation and retain its wildlife, and to prevent floods and soil erosion.

We believe that Congress should establish a national water policy which would begin with the individual or the corporation and leave to him or it that which he or it can do to develop resources and conserve water. That development which requires collective action should be accomplished at the lowest governmental level practicable. The scope of the duties of the Federal Government should be defined and the limitations on its activities set forth in this statement of policy.

We think that the national water policy should be administered in fewer agencies.

Water quality standards should be set up which are realistic, flexible, and allow for disposal of liquid wastes which do not exceed the capacity of the stream for self-purification.

In any Federal legislation on this subject, the principles of State control and local initiative and responsibility should be preserved. The

States concerned, acting individually or through compacts, should enact appropriate laws and deal with pollution through agencies vested with authority and responsibility to establish, enforce, and administer suitable regulations.

While recognizing the primary responsibility and authority of the States, there should be adequate Federal authority in the background to be invoked if and when the State demonstrates either inability or unwillingness to do its own job.

Flood-control planning should take the form of research in capturing water at its source to keep runoffs steady and normal and the development of watershed and basin projects. These basin development programs should take the form of participation by citizens, communities, and States, with the Government lending advice. The U.S. Government should furnish financial help only when national defense is involved or public benefit is nationwide. There is widespread dissatisfaction with further development of water resources along the Valley Authority lines, and particularly to the development of power and steam operations by the Government.

Emphasis should be placed on reuse of water, particularly cooling water in industry. Additional support should be given to the efforts of the Soil Conservation Service, whose program not only is sound and practical but will ultimately be the least expensive and in the spirit of American free enterprise.

As a company and as individuals in the company, we pledge our assistance, if requested, to this committee in studies or furnishing of facts which will aid in formulating this most important program for the growth and welfare of our Nation.

Senator HART. Mr. Gillespie, thank you very much.

You should not have told us that the mail was delayed in reaching you, because it sounded like a thoroughly prepared statement.

Mr. GILLESPIE. Thank you, sir.

Senator HART. These recommendations, I am certain, will be given consideration by the committee. They certainly stimulate one's imagination, but the one that gets the most general agreement is the third item, namely: "The national water policy should be administered in fewer agencies." Human nature being what it is, I am sure this does not get universally enthusiastic reception.

Mr. GILLESPIE. I am sure of that.

Senator HART. But my own impression is that this is something we should carefully consider. You were nice enough not to say it, but let me say it: there are those who think there should be fewer congressional committees concerned with water, having jurisdiction over aspects of water. I say this seriously. I think here, too, there is room for improvement. I do not want to fly the colors of an expert after less than a year in the Senate, but I sense that while it will not be easy to resolve, we would have a better chance for an overall national water policy if there were fewer cooks. As I say, it is easier said than done, but I think this is sort of our basic policy.

Mr. GILLESPIE. I agree with you completely, Senator, and I feel that the activities of this committee are particularly important, because you have gone out and you are making these local surveys and you are going to get a mass of facts. They are going to be conflicting facts, which you will have to resolve and work out a program from

them, but at least you will have the facts on a better basis because of this widespread investigation that you are carrying on. I am particularly pleased to see the wonderful job you are doing on it.

Senator HART. You are certainly helpful.

Thank Mr. Whiting and Mr. Powers, too.

The Detroit Board of Commerce have been invited. Willis Hall planned to come but was not able to at the last moment. He will submit a statement which will be made a part of the record.

(The information referred to follows:)

STATEMENT BY WILLIS H. HALL, GENERAL MANAGER, GREATER DETROIT BOARD OF COMMERCE

Water is a basic resource for which there is no substitute in its essential domestic industrial and commercial uses. Natural cycles replenish the supply in such a fashion that our problem in connection with water is one of proper management, not inadequate supply.

The Detroit area is indeed fortunate in its location on the Detroit River where the water of three of the Great Lakes flows toward the sea. The city's site was selected because of its strategic place on a vital commercial route. Detroit's development into a huge industrial complex is due in a large part to the presence of this waterway which provides not only a mode of transport for raw materials and finished products but meets the needs of industrial processing and domestic use.

Detroit is well aware of the increasing demand for water which will come with future growth and has taken steps to be prepared to meet the needs with which your committee is concerned. For decades the department of water supply has augmented its facilities. Within a short time a second intake will be in service, providing a source close to a developing area and lessening the danger of a calamitous disruption of service. Projected for the future is a third intake, designed to bring the pure water of Lake Huron to the Detroit metropolitan area. Detroit's Department of Water Supply, looking far into the future, has undertaken an efficient, effective program designed to meet the needs of the metropolitan area in regard to supply and transmission. The distribution systems are the responsibility of the individual communities.

Supplying water is only part of the problem. Disposing of it in proper fashion is of equal importance. Here, too, the local communities, with the Detroit Department of Water Supply taking the leadership, are working with their eyes on the future. Shortly the six-county area will undertake a comprehensive survey of sewage and drainage needs.

With the counsel and guidance of State and Federal agencies, the water, sewage, and drainage problems are being handled at a level close to the people, financed by those who use the systems.

This is as it should be. The local community is accepting responsibility for meeting its needs and looks to higher levels of government only when certain phases of the program make it unavoidable.

State agencies, such as the health department and water resources commission in Michigan, have major roles in the development of local programs although the basic responsibility should remain with the lower level of government. When the involved area crosses State lines or concerns border water, interstate organizations should be created to work out the answers. Such groups, close to the problem, are preferable by far to surrender of responsibility to a Federal agency.

In some cases, such as the Detroit River, there is international concern and the situation calls for a working arrangement between countries. But in every case the basic responsibility should remain with the lowest level of government that can effectively meet the problem.

The Government of the United States should have a water policy. At present many Federal agencies are concerned with water and disposal in one regard or another. A Federal water policy should clearly define the scope of Federal activity in this field, limiting participation to those phases which cannot be handled otherwise.

The Government of the United States has many problems with which to contend. It should not complicate its difficult situation by invasion of fields properly within the jurisdiction of local and State government.

Detroit's Department of Water Supply is embarked on a long-term program that will met the problems of supply and disposal in the future. The Michigan Water Resources Commission can be depended upon to continue its vigilant protection of the public interest in the control of contamination.

In a recent study of Michigan, known as the Haber or Upjohn report, the field of water resources was suggested for study by the Committee on Michigan's Economic Future. This organization is now in the process of setting up such a group through which the best minds in the State can give attention to water resources.

Southeastern Michigan's major power facility, preparing for the increased demands of the future, estimates that by 1980 it will have doubled its use of water for cooling. The return of this water to the Detroit River, even at the increased rate, will have an imperceptible effect on total water temperature, thereby assuring continued good conditions for recreational, fish, and wildlife uses.

The Detroit area is demonstrating its ability to meet its responsibilities in the field of water resources. Other areas are writing equally effective records. This acceptance of responsibility at the local level should be encouraged by the Federal Government through a hands-off policy except where particular circumstances require its limited participation.

Senator HART. The Detroit Metropolitan Area Regional Planning Commission. When we listened to the Huron River watershed testimony we noted on the letterhead the Detroit Area Commission represented on its board.

STATEMENT OF PAUL REID, DETROIT METROPOLITAN REGIONAL PLANNING COMMISSION

Mr. REID. Thank you, Senator Hart.

I think I am directing your attention at the other end of the telescope when I speak for the Detroit metropolitan area after the previous person had spoken of the State as a whole and the Nation.

Looking at the focus on a comparatively small area——

Senator HART. Quite a few people live here.

Mr. REID. Yes, that is for sure.

As the official planning agency for the counties of Wayne, Oakland, Macomb, and Monroe and the four eastern townships of Washtenaw County, we welcome this opportunity to make a statement on the vital matter of water resources in this 2,710-square-mile area. We are concerned not only that the families and economic enterprises of this important section of the State of Michigan be provided with adequate water services to meet their needs of today, but also that the needs of the larger population and the greater economy of the future be handled wisely and in advance.

Today, water services are supplied to the over 4,200,000 people of the six southeastern Michigan counties (Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne) from the Detroit, Huron, and Clinton Rivers and from ground water sources. The largest single system, that of the Detroit Water Board, provides service to some 3,247,000 of these people, from one intake in the Detroit River. The inadequacy and vulnerability of this single intake have been recognized by responsible authorities and plans for additional intakes in Lake Huron and the Detroit River are well advanced.

Population in this six-county area increased 890,000 from April 1950 to July 1958, according to estimates of the Michigan Department of Health, supported by our own estimates. By 1980, we anticipate that the population of the area will range between 6,050,000 and 6,804,000, constituting an increase of an additional 1,842,000 to

2,596,000 people. Over 80 percent of the 1980 population will be living in urban areas and hence will require public sanitary services, both water and sewer.

Total employment in the six-county area is projected to rise from 1,294,000 in 1950 to 2,311,000 in 1980, an increase of 1,017,000. Manufacturing employment is expected to rise from 595,000 in 1950 to 1,021,000 in 1980, a gain of 426,000. Although there is a wide range in manufacturing water use per employee today among the industries of this area, it is anticipated that by 1980 the average per employee use of water in manufacturing will rise significantly.

Southeastern Michigan is fortunate in having within a reasonable distance ample water supplies for its people and its economic enterprises. Surface resources consist of the Detroit River, Lake Huron, and Lake Erie. Ground water resources are limited and spotty in location.

The pressing problems here today are not water resources, but transmission, treatment, shortage, and distribution of water to the over 200 governmental units of the six-county area. Of equal importance and urgency is the economic and nonpolluting disposal of water supplied to the families and businesses of the area.

The major features have been developed for what appears to be a feasible and adequate water system to supply the needs of the central three of the six counties of the area. This system needs to be expanded or supplemented by related systems to service the other three counties.

As yet, no comprehensive sewerage and drainage system, or set of systems, has been developed to service the six-county area. For continued growth and for public health, it is mandatory that such a system be created. The continued use of septic tanks in residential areas, industrial and public pollution of streams due to inadequate sewerage treatment and storm flow are real and present dangers to public health and private decency.

Plans for a comprehensive water system and for a companion sewerage and drainage system need to be wrought well in advance of anticipated needs, and progressively financed and constructed to keep constantly ahead of developing need, both from an economic and a health standpoint.

More attention is required to the conservation and economic use of water as a vital economic and social resource. An undue amount of rainfall is lost to the area due to a lack of storage and impounding facilities on the one hand and to increasing amounts of land being covered by urban developments.

Our studies of land use in the three central counties (Macomb, Oakland, and Wayne) reveal that from 1949 to 1958 a total of 243 square miles of territory were developed for residential, commercial, and industrial uses. This was a 49 percent increase in a period of only 9 years. The population increase in this same period was only 29 percent. This is to say that developed land increases at a faster rate than population which I think is an important item.

Flood control has become more urgent with the urban development of every additional square mile in each of the major river basins of the area. Since 1950, over 325,000 dwelling units have been erected in the six-county area, 93 percent of them single-family homes. Over

70 new manufacturing plants, each employing from 100 to 5,000 workers in one-story structures, have been built since 1950. Some 26 regional and community-size suburban shopping centers have been developed in our region since 1953 on 778 acres of land, and occupying 6,791,250 square feet of floor space and providing 64,150 surfaced parking spaces. Add to these land-covering developments, the 125 miles of expressways recently constructed in the region and the mounting runoff problem attains dangerous significance. The conservation and control of storm waters and the prevention of floods has come to be a major urban problem in southeastern Michigan.

In this connection, the handling of another pressing urban need should also be considered. The provision of regional recreational lands now, before open areas are developed into home, industrial or commercial uses, is imperative. Land in the major river basins that should be preserved as flood plains or developed as impounding areas for storm waters can well serve the dual purpose of open recreational areas for our mounting urban population in this section of Michigan.

In the private sector of our six-county community, an enterpriser with a good business prospect can obtain bank loans and/or private backing to build for his anticipated volume of future operations. But in the governmental sector of the area, the needed funds to build for the future are not so readily obtained. Funds are needed now to build the metropolitan community capital water services plant and the capital sewerage and drainage plants that will be needed in 1970 and 1980.

Advanced planning now and progressive construction—ahead of residential, industrial, and commercial developments—can be done at lower dollar and social costs, than waiting until spreading growth has raised land values to excessive levels. The Federal Government's stake in the continued healthy and economic growth of this six-county area, and similar areas in Michigan and other States, might well warrant the establishment of a loan fund for such public capital plant expansion on a comprehensive scale.

Senator HART. I am not sure which end of the telescope or whatever you said you were looking through, but you certainly had it in focus. That was an excellent statement and I think pretty vividly will describe to the committee the nature of those of us who live in and the kind of land we stand on here in southeastern Michigan.

Mr. REID. We are very happy to have been here.

Senator HART. Congressman John Lesinski had intended to be here today. Unfortunately he was not able to attend, but at his request and speaking for the Dearborn Chamber of Commerce we have scheduled Mr. Chapman.

STATEMENT OF RICHARD CHAPMAN, EXECUTIVE VICE PRESIDENT, DEARBORN CHAMBER OF COMMERCE

Mr. CHAPMAN. Thank you, Senator.

I might preface the statement that was prepared that Congressman Lesinski called me the day before yesterday and asked if a short statement could be prepared. I might add that he has really spark-plugged the Rouge River flood control. We have a problem here. Of course, we are just a small segment of the statement that was made preceding me.

However, we do encompass a great deal of area there.

I would like to say that Dearborn has been blessed with a phenomenal population growth during the past 20 years. In 1950 our population was 94,000-plus, and now it is around 130,000. In some areas vacant land for residential purposes has been decreased to a point where there are very few vacant lots left. There is very little industrial or commercial land remaining, with the exception of a center area of a few thousand acres out of 25-plus square miles. As a result, we are a large user of water and, during the past 20 years, our water consumption has increased from 369,727,295 cubic feet to 944,636,863 cubic feet. Some of our largest industrial users have water that is not taken through city mains. We, like other adjacent communities, would suffer greatly from the lowering of the water level in this area.

While we are pleased with the increase of population and growth, we are also having a bond issue voted upon on November 3, 1959, in the amount of $5,700,000 to enlarge the relief sewers in Dearborn. With the exception of the one area noted, we have practically covered our city with roofs, sidewalks, or pavements. Because of this growth and ground coverage, the former normal ground absorption has ceased to exist. The immediate runoff from any cloudburst now causes floods in many areas of the city. As an example of our growth, the northwest section of our city, between 1940 and 1950, had a population growth of 3,000 plus to 13,000 plus. There is hardly an unused lot left in this area. The southwest section has increased from 22,000 in 1940 to 72,000 in 1950—add another 10 years of growth and there is hardly another vacant lot left in this area.

The city of Dearborn, in relation to the Rouge River, is like the neck of a bottle, as all three branches merge and flow through into the Detroit River. The Rouge River drains an area starting in Washtenaw County on the west and extends almost 25 miles north to Pontiac, Mich. On the east, it extends into the western and northwestern areas of Detroit. There is a drop of more than 60 feet from Oakland County and Dearborn. The U.S. Engineers have made a very thorough study and have found that there is great danger of flood hazard in this area.

Prof. C. O. Wisler of the University of Michigan who is one of the foremost authorities in the country on matters such as waters, floods, et cetera, has stated that the right combination of frozen ground, saturation, snow and a few inches of spring thaw, could cause a loss of life worse than in the Dayton flood of 40 some years ago. The damage would be in the hundreds of millions to industry and residents, and the population loss of life is impossible to measure. This Rouge River drains 292,789 acres of land.

It is most necessary from an economic and health standpoint that Dearborn continue to have available ample water to take care of future growth in population and industry and, likewise, to have relief from the hazard of floods that could cause irreparable damage to our industries, and injury to our population.

Thank you very much.

Senator HART. I thank you.

I am satisfied it will be helpful to this committee to have in that very brief form a narrative explanation of the situation of the city which is at the bottleneck, as you say, because any drama you can add to this

thing the more apt it is to be retained in the memory of the people. It is a river on which sits an industrial empire that every member of the Senate knows about as soon as he hears about the Rouge River, the Rouge plant.

This, I am sure, will be helpful.

Mr. CHAPMAN. Thank you, sir.

Senator HART. There is also the intention of the Congressman from Michigan's 14th Congressional District, Congressman Louis Rabaut, to attend. A very close friend and a lawyer whom I know, a very close friend of Congressman Rabaut died, and he would not be able to return from the funeral until very late this afternoon. He will probably not be able to appear, but I would like to say that his record will testify to his interest in this subject of water resources over the years.

We hope to close on an international note.

For the Canadian-American Committee on Water Pollution, which Mayor Patterson of Port Huron commented on earlier, we will hear from Mr. Robert Reese; Mr. Reese also has a statement from Mayor Miriani.

STATEMENT OF ROBERT REESE, ASSISTANT CORPORATION COUNSEL, CITY OF DETROIT, MICH., REPRESENTING THE CANADIAN-AMERICAN COMMITTEE ON WATER POLLUTION AND MAYOR MIRIANI

Mr. REESE. Thank you, Senator Hart, Congressman O'Hara.

Actually, I am appearing today in a somewhat dual capacity.

I am appearing on behalf of His Honor, Mayor Louis Miriani, mayor of the city of Detroit, as I guess all of you know here, who has a statement that he wanted me to present, and I am also appearing on behalf of the Canadian-American Committee on Water Pollution, a committee composed of a large number of communities in this area.

I recognize the fact that this Senate committee is rather pressed for time at this point. I have filed both statements and recognizing that you want to get a plane out of here rather soon I will just endeavor to summarize briefly this one by Mayor Miriani. There are a couple of points I would like to make, if the committee would permit it.

Senator HART. I think the mayor will understand what I mean when I say what I am about to say though it is very dangerous. He was kind enough to greet Senator Kerr and the committee staff last night. I know he had hoped to be here in person. I would suggest in view of that and his indication of interest that we place on the record, in full, his statement and you go right to the point of the other role that you have assumed.

Mr. REESE. I wish to express my sincere thanks for the opportunity to discuss with you the concern of millions of Americans in this area regarding the protection of our quality and quantity of water.

An adequate supply of fresh water has always been one of the basic requirements for a prosperous community. Detroit and the cities directly on the Great Lakes or its connecting rivers have much to be thankful for in that we were provided with an adequate supply of the finest water in the world. It is our duty to protect both the quantity and quality of this God-given heritage.

Cities of our great State of Michigan, not as fortunate as Detroit, are faced with problems of providing themselves with an adequate supply of quality water. Many areas of the State, depending on wells for their supply, have found that the water was not of high quality in many cases, and often, during certain periods, was of inadequate quantity. Many cities have transported water by large pipelines from the Great Lakes to the interior. Others are making plans at this time.

It behooves Federal, State, and local governments to recognize the value of our Great Lakes water supply and to join hands in protecting it.

Detroit, located in a favorable position geographically where we have been able to pump the necessary water from Lake St. Clair, has developed a first-class water supply system which has provided their full supply to a large area outside Detroit.

We are now in the process of adding to our facilities so that we might continue to supply a large portion of the metropolitan area first-class water for the next 50 years, at far below the average cost. Being responsible for the water supply of over 3 million people and planning for more than 4 million, we must be alert as to anything that might be harmful to this supply.

There is no advantage in having an unlimited supply of water if it is to become contaminated by the oil industry or polluted by inadequate sewage treatment plants. The contamination of our supply has been gradually increasing. Hardness, due to wastes, reached an all-time high in 1957. Phenols are existent regularly and industrial activity in the oil industry in Sarnia, which has resulted in much of this problem, is on the increase.

There is a further threat in proposals to explore for oil in the lake bottoms along the Canadian shore. Detroit has joined with its Canadian neighbors and our Michigan friends in studying the effects of oil drilling in our lake bottoms. We have been able to stop the drilling temporarily while completing our study.

We are sure that our Canadian neighbors are anxious to join with us in protecting the quality of the water in the Great Lakes. The International Joint Commission has given serious consideration to this problem of contamination and pollution, and, no doubt, will make every effort to see that both countries do everything possible to protect our water supply.

The diversion of water by the city of Chicago from the Great Lakes to the Mississippi Basin could have serious effect on not only our water supply, but on our shipping as well. Hundreds of millions of dollars are being spent to provide channels between the Great Lakes and the Atlantic seacoast. Every inch of water is important to shipping, and we in this area are greatly opposed to any further diversion of water by Chicago for the purpose of flushing out their sewage canal.

Our State water resources commission and the State and Federal health departments have done a fine job in the past in protecting the water of the Great Lakes and its tributaries. The Federal Government has been very considerate in assisting communities to provide adequate sewage disposal facilities in order to protect the quality of the water and the health of our citizens.

The passing of legislation by Congress for further diversion of water from the Great Lakes is not in the best interests of the Great Lakes area. We request that this committee go on record as being opposed to any further diversion and make every effort to convince Congress that any legislation for further diversion should not be passed.

We are very happy to have had the pleasure of your visit to Detroit and only hope that our few remarks will be of some help to this important committee in further consideration of the Nation's water problems.

Senator HART. Thank you, Mr. Reese.

Mr. REESE. I would like, first, to clear up one item that was brought up by Mayor Patterson, and then there was a brief discussions about it, namely, the intent or plans of the city of Detroit and Flint to build tunnels to Lake Huron. I just did not want to leave this committee with having any doubts about the plans.

Flint, I understand, has already issued and I would not say sold, but issued some $90 million worth of bonds to finance their water tunnel to Lake Huron. Detroit has spent a large amount of money for engineering studies, and it is something definitely in the water department's plans. To change it would be a complete about-face at this time. We expect to be up getting water from Lake Huron, I think, within the next 10 years.

Senator HART. The water thus withdrawn from the lake would return to the lake, wouldn't it, or would it remain in the watershed?

Mr. REESE. As I understand, and I am not an expert in that field, we are in this watershed area. It would flow back. That is from Detroit, it should go back into the lakes except that which another witness here this morning indicated there is a certain amount of evaporation and total consumption of water, somehow or other, I am not the expert, but I think a large amount of it will go back.

I think, Senator Hart, you did raise a good point though, on the ground of friendly relations between two countries, possibly Canada would wonder a little bit about how much water we are taking out. I do not know. I am speaking unofficially on that one; I hope you understand.

Senator HART. My question was purely for information.

Mr. REESE. Mayor Patterson referred to the drilling in the St. Clair River. What happened there, as you already know, public opinion was so aroused that the Ontario government did not issue or indicated it would not issue immediately this permit to drill in the vicinity of Sarnia. At that point the company backed down on its request, so the issue is dead for this year.

However, I am sure they intend to reapply for a license to drill and all the other communities, Flint, Port Huron, Detroit, Sarnia, a number of organizations, townships, and counties—I will not go into here—got together and formed this committee known as the Canadian-American Committee on Water Pollution. I am a member of that Committee through authorization of the mayor and the Common Council of the City of Detroit.

So on that question the executive and the legislative branches of our Government are in full accord.

The general principal objective of the committee is the adoption of laws prohibiting the drilling for oil and gas on the Great Lakes or their connecting waters. Such laws should be passed by all States of the United States that border the Great Lakes, and of course, the Province of Ontario, Canada.

The difficulty in achieving this end for it contemplates action by a total of nine different legislative bodies, leads this committee to the view that possibly the problem is one for the respective Federal Governments of Canada and the United States.

Up until recently I did not realize and I am disgressing a little here—I did not realize there were eight States bordering the Great Lakes. I was under the impression there were seven. The one I missed was Minnesota. It was a terrible oversight because I mentioned that to the International Joint Commission and the chairman of the American Section was from Minnesota.

Senator HART. We think all of those long ships that pass in the night are from Michigan.

Mr. REESE. Of course.

Senator HART. There are a lot of them.

Mr. REESE. In fact, I figured they were all from Detroit.

Other witnesses here have mentioned the importance of a pure, wholesome supply of water to all the various aspects of our economy. That is, in my judgment, and I do not see any reason for repeating it now.

In short, there are so many of our industries, communities, and so one, that need pure water, and it need not be belabored, but the principal idea that I would like to get across is this oil-drilling thing.

The question might be well asked as to what makes us feel that oil offshore drilling in the Great Lakes causes pollution. Does it in fact cause pollution?

The committee feels the answer to this question is it can cause pollution, it has caused pollution, and there has been no assurance given this committee from any source to date but it will not or cannot cause pollution. In support of our contention that it does pollute, we need only direct this committee's attention to what happened when the first offshore oil well came in in Lake Erie near Colchester, Ontario, last summer. Hundreds of barrels of oil were spilled into the lake. The occurrence was referred to as an accident which would not occur again. However, it did happen again and at the same well.

A number of the residents in the area have described these occurrences in sworn affidavits. They supported their reports with photographs of the oil flowing high above the platform; of clam shells on the shore partly filled with crude oil; and of samples of water taken from the lake showing a thick layer of oil floating on the surface of the sample. Moreover, these facts were not and are not denied by the company responsible for this occurrence.

It is important to note that this pollution of the water resulted from just one well. If oil is found in appreciable quantities, as indeed it may well be, it is reasonable to anticipate hundreds, if not thousands, of wells will be drilled in the Great Lakes. Under such circumstances, the cumulative effect of these so-called accidents poses so serious a threat to the waters of the Great Lakes that the Canadian-American Committee takes the position that no upshore drilling should be per-

mitted. The problems here are not comparable with the problems found in offshore drilling in the Louisiana gulf area or in California. Here we have major differences creating problems outside past experience in the field.

The first problem is that of ice. The effect of ice on offshore drilling installations is an unknown factor. A second distinction is of course that here we are dealing with fresh water. It is therefore the position of the Committee that we should not risk destroying this invaluable natural resource, the waters of the Great Lakes, for the sake of obtaining another natural resource which still can be acquired elsewhere in quantities large enough to satisfy our present requirements.

Thanks very much.

Senator HART. Thank you very much.

You do not leave the easiest problem of all to the last.

Mr. REESE. No; it is very difficult. As I say we have taken it up with the International Joint Commission. I do not know what action that body might take, but we firmly believe it is a very serious problem and this committee is quite active and has a lot of enthusiasm. We are hoping we will be able to get some legislation passed.

Senator HART. Thank you very much. And thank Mayor Miriani.

(The prepared statement of Mr. Reese follows:)

STATEMENT BY ROBERT REESE, ASSISTANT CORPORATION COUNSEL, DETROIT, FOR CANADIAN-AMERICAN COMMITTEE ON WATER POLLUTION

Gentlemen, early in August of this year a drilling platform was erected in Lake Huron near the mouth of the St. Clair River by Mineral Explorations, Ltd., a company engaged in the business of drilling for oil and gas. The purpose of the platform was, of course, to drill for oil. The reaction of the cities in the immediate area, along with other groups, such as commercial fishermen, was immediate and vocal. Protests were filed with the Ontario Fuel Board opposing the issuance of a license to drill. A delegation composed of representatives of the cities of Sarnia, Port Huron, Detroit, the township of Sarnia, the county of Lambton, and the Commercial Fishermen's Association of Southern Lake Huron appeared at a meeting in the office of the Minister of Mines in Toronto to voice objection to the granting of the license to drill for oil.

The net result was a withdrawal on the part of the company of its application for the license, thus terminating the problem for the current year.

Thereafter, recognizing the fact that the relief was only temporary and that legislative action would be necessary to prevent a repetition of this problem in future years, participants in the protest formed what is now called the Canadian American Committee on Water Pollution.

Membership in the Committee is as follows:

J. W. Murphy, M. P., Lambton West, chairman.
H. G. McKittrick, secretary.
Alderman Ruth Ronohue, Sarnia.
Alderman, W. S. Pearson, Sarnia.
H. V. Sutton, Ontario Federation of Anglers and Hunters.
Murray McLean, Lake Erie Fisheries Council.
R. T. Purdy, Lake Huron Fishermen.
Robert J. Egan, mayor, city of Flint, Mich.
Ronald T. Craig, vice mayor, city of Flint, Mich.
W. D. Sinclair, Brigden, Ontario.
Sheppard McCallum, Sombra Township.
Fred Gallie, reeve, Forest.
H. G. Williamson, councilor, Sarnia Township.
Reeve, George E. Cole, Sarnia Township.
Ken W. Gray, reeve, Wyoming.
Alvin Laur, reeve, Courtright.
Charles Young, deputy reeve, township of Moore.
Alderman J. Ralph Knox, Sarnia.

W. H. A. Thomas, M. P., Middlesex West, Strathroy, Ontario.
Robert Reese, deputy legal adviser, city of Detroit.
John C. Ayers, Great Lakes Research Institute, University of Michigan.
Mayor Walker, city of Sarnia.
R. G. Given, city manager, city of Sarnia.
Joseph G. Molner, M.D., health commissioner, city of Detroit.
Fred Charlton, Petrolia.
F. A. Fitzgerald, Petrolia.
C. A. McKenzie, St. Clair River Research Committee.
W. H. Palmer, Sarnia parks and recreation.
L. A. Kenyon, city engineer, Marysville.
J. S. Johns, mayor, city of Marysville.
Cal Lakin, city manager, Port Huron.
Richard Riley, assistant to city manager, Port Huron.
John S. Smart, Sarnia Chamber of Commerce.
Mr. Zeb Janes, M.L.A., Lambton East.
Mr. E. J. Jacques, representative, Lake Shore Property Owners.
Senator Frank D. Beadle, St. Clair, Mich.

In general, the principal objective of the committee is the adoption of laws prohibiting the drilling for oil and gas on the Great Lakes or their connecting waters. Such laws should be passed by all States of the United States that border the Great Lakes and the Province of Ontario, Canada. The difficulty of achieving this end—for it contemplates action by a total of nine different legislative bodies—leads this committee to the view that possibly the problem is one for the respective Federal Governments of Canada and the United States.

Let us now take up some of the reasons why the commitee feels prohibitive legislation is required in this area.

First of all, many, many millions of people rely on the Great Lakes as a source of pure water for human consumption. Contamination or pollution of the water results in the expenditure of millions of dollars for the filtration and purification facilities necessary to make the water fit for drinking. Increasing pollution increases the cost of operating these facilities. Nor is the need for pure water limited to its use for drinking. Many industries need pure water for processing of the products they manufacture. Thus, any potential source of pollution is of vital concern to all communities, units of government, and others who take water from the Great Lakes or their connecting waters.

There are other segments of our economy affected by water pollution. The commercial fishing industry is one. Pollution is a threat to the very existence of this large segment of our economy.

Another affected industry, and perhaps a corollary to the former, is the hunting and fishing industry. This, too, is a tremendous part of our economy which would face disaster if the fishing and hunting grounds were to be destroyed by contamination of the waters.

Still another segment of our economy which depends in a great measure upon the Great Lakes is the tourist industry. Contamination of beaches and the adjoining waters would be ruinous to this group.

There is still another group that would be adversely affected by pollution. We refer to those individuals who have paid premium prices for waterfront property on which to build their homes or summer cottages. These people will not only be affected by pollution but are affected by the offshore oil drilling itself due to the unsightly drilling platforms and the accompanying noise of the driling rigs operating in front of their homes, in some instances on a 24-hour basis.

We have mentioned those who would be affected by pollution of the Great Lakes (and there may be others) and we may well be asked if offshore oil well drilling does in fact pollute the waters.

The committee feels the answer to this question is: It can; it has; and there has been no assurance received from any source to date that it will not.

In support of our answer we need only to direct your attention to what happened when the first offshore oil well came in in Lake Erie near Colchester, Ontario, last summer. Hundreds of barrels of oil were spilled into the lake. The occurrence was referred to as an "accident" which would not occur again. However, it did happen again and at the same well.

A number of residents in the area have described these occurrences in sworn affidavits. They supported their reports with photographs of the oil blowing high above the platform; of clamshells on the shore partly filled with crude oil; and of samples of water taken from the lake showing a thick layer of

oil floating on the surface of the sample. Moreover, these facts are not denied by the company responsible for the occurrences.

It is important to note that this pollution of the water resulted from just one well. If oil is found in appreciable quantities, as indeed it may well be, it is reasonable to anticipate hundreds, if not thousands, of wells on the Great Lakes. Under such circumstances, the cumulative effect of these so-called accidents poses so serious a threat to the waters of the Great Lakes that this Committee takes the position that no offshore drilling should be permitted. The problems here are not comparable with the problems found in offshore drilling in the Louisiana gulf area or in California. Here we have major differences creating problems outside past experiences in the field. The first problem is that of ice. The effect of ice on offshore oil installations is an unknown factor. A second distinction is that here we are dealing with fresh water not salt water.

It is, therefore, our position that we should not risk destroying this invaluable natural resource, the waters of the Great Lakes, for the sake of obtaining another natural resource which still can be acquired elsewhere in quantities large enough to satisfy our present requirements.

Senator HART. It is inconceivable that we would conclude the prepared list of witnesses at the time scheduled and called for, but, if my watch is right, we are 3 minutes ahead.

I hope that none who were invited and who came were neglected to be called. I have checked all who were on the list given me. Nonetheless, if we have failed in this regard, by all means, let me know before we leave and we will add to the record the statement that has been prepared.

I appreciate very much Congressman O'Hara's attendance through the day, though it does not surprise me a bit. I know the hearing has been helpful to me. I am sure it will be for the committee.

Mr. SCHAD. Senator, may I say a few words at this point.

I would like to say that this has been one of the best hearings that we have had. I have had the privilege of attending all of the hearings that Senator Kerr mentioned earlier today. I think I ought to say a word about how this hearing was arranged.

This committee has a small staff. You are looking at most of them right now. We cannot arrange all these hearings, and so we turn it over to the Senator in the area in which the hearing is to be held, and that was your own Senator, Phil Hart, and I think he has done a superlative job as far as the committee is concerned. When I say that I am speaking in behalf of our chief clerk, Paul McBride—and I know that the worries have just been lifted off his shoulders by the wonderful job that has been done here—I think I should also give due credit to Senator Hart's assistants, both of whom, in essence, are staff members of this committee for this hearing.

Bill Welsh has been mentioned earlier. You all know him. And Fred Burke and Muriel Ferris. I am sure you know them. And Shirley Guinot. I understand she had to work last night and has gone home.

They have done a wonderful job of arranging this hearing, taking care of the details and welcoming the committee. We really feel as if this hearing, with these wonderful statements by your industries, by your university people, and by your local government and State governments of the region, has been a great help and will be a great help in assisting this committee to find the solutions that it is seeking.

I am confident if we can just keep people like you thinking about these problems and deciding what you think should be done and telling your elected officials, I do not think we are going to have any problems at all that cannot be solved in the American, democratic way.

It certainly is a privilege to be here and I am very happy that I was able to come.

Senator HART. Thank you, Ted.

I know all of us who sat through the day, if given little slips of paper on which to vote as to which was the one thing that struck us most of all, would come up with as many different votes as there are men and women present here. I am not sure how I would cast my vote; but one thing did strike me as good, and that was the emphasis, whether it was from a Government spokesman, an educator, an industry representative, that basic to all this is the necessity for additional research, research in all aspects of the problem, and I thought it a lucky hearing that we assembled in an American, democratic setting and on a campus.

I think if eggheads can gain comfort from any congressional hearing, they could look on this one as one where they were not abused and indeed were encouraged, even to the point of the suggestion we use hydrogen to explode and get aquifers.

Again, thanks to all of you who participated. I am very grateful, and I hope that at the end of this long road the committee can come up with a report that makes sense.

It will not make everybody happy, but I hope it is in the long-term good of our country.

Thank you very much.

(Whereupon, at 3:12 p.m., the committee recessed, Thursday, October 29, 1959.)

(Subsequently, the following letters and statements were received to be added to the record:)

STATEMENT OF THE STATE OF MINNESOTA DEPARTMENT OF CONSERVATION

Just what information the committee wished to secure from the State of Minnesota is not clear from the statement received. However, it is assumed the primary interest of the committee is in those problems which would be affected by national water policy, if such a policy is established.

There are no quantitative estimates of either surface or ground water, insofar as the total present use, the total volume of water available for use either stored on the surface or below ground, nor any reliable estimate of the safe yield to which present usage could be expanded in the years that lie ahead. It is agreed that such figures are necessary, and an effort currently is being made to ascertain these value in the Twin City metropolitan area by the division of waters of the department of conservation. The estimates that have been made heretofore by the U.S. Geological Survey in Circular 274, "Water Resources of the Minneapolis-St. Paul Area," are based on too meager information to be reliable.

Nor has anyone estimated accurately the total present use for the State as a whole. In 1950, the division of waters estimated the total use from the then available data in the State as 452 million gallons per day. That division also estimated that in 1975 the total usage would approximate 672 million gallons per day. It is estimated that the population of the State of Minnesota will expand in the Twin City area alone by the year 2000 by 1 million persons. These facts are of concern to all State agencies concerned with water supply or the control of pollution.

The following is a brief outline of some of the policies which the State of Minnesota considers important on a national level:

1. All water development projects, whether State or Federal funds are involved or not, should be sponsored, constructed, and operated at the lowest level of government possible.

2. An equitable uniform method of computing benefits and costs must be established and a clear statement made as to the manner in which Federal Government will participate, if at all.

3. Some circumscribing statement must be found which will permit intangible benefits to the local communities or the State as a whole to be included in project cost estimates which might permit a project with a low ratio of benefits to costs to be constructed and participated in by the Federal Government.

4. Investment of public funds for the construction of storage reservoirs must be protected. Our concern in this matter is based on the experience that Minnesota has had with the six navigation reservoirs in the headwaters area of the Mississippi River, Winnibigoshish, Leech, Pokegama, Big Sandy, Pine River, and Gull constructed between the years 1884 and 1912. Continued encroachment upon the rights acquired by the Federal Government when the reservoirs were constructed has occurred by reason of leasing of lands by Federal agencies and the permitted purchase of lands by individuals and resort owners. This encroachment has defeated the purpose for which the reservoirs were built and intended. The reservoirs now are operated at less than 30 percent of their potential capacity, based on the rights originally acquired at the time they were built. This leads us to the recommendation that whenever the Federal Government acquires rights for the storage of water for flood control or for storage for beneficial use other than recreation, the rights so acquired shall be kept inviolate and no leases or sales shall be made that would lead to restrictions on fluctuation of water levels that would impair the usefulness of the impoundment for purposes other than recreation or flood control.

5. Water resource projects of considerable public value for water supply, flood control, pollution abatement, and other purposes have been impeded, restricted, or stopped by the protests and organized opposition of those interested primarily in the preservation of fish and wildlife habitat. These and other recreational interests are of great public value; but they should not be allowed to dictate in projects where other public interests are paramount.

6. A policy should be adopted or enacted by statute requiring all Federal agencies to comply fully and completely with State law.

7. Except in matters relating to national defense, disclosure of intended projects by the Federal agencies should be made to the corresponding State agency when planning is begun.

8. If and when any allotments are to be made for any purpose to the various States by the Federal Government, the expenditure of such allotments or gifts shall be by State agencies and not by Federal agencies. Such allotments might be for highways, water pollution, development of water supplies, or other purposes for which funds might be made available, on a matching basis or otherwise.

9. The State should be represented on all commissions which may affect the boundaries or the waters of the States involved. In other words, the International Joint Commission in dealing with problems involving Minnesota and the Provinces of Manitoba and Ontario should be expanded to include at least one member from each State or Province affected. In other words, the States and Provinces should participate in the decision in matters affecting such States or Provinces.

10. Compacts: Whenever it becomes necessary to create a compact between two or more States, the compact documents should be simple and the commission or board set up to administer such compact should act only in emergencies.

11. To summarize some of the foregoing, it is our belief that the Federal Government might well furnish leadership and some of the money necessary to construct projects or to perform certain functions that are of national interest, such as flood control, water supply, water pollution control, flood plain zoning, etc., but should not dominate the expenditure of the funds nor the planning of the projects. These matters should be largely State and local affairs.

STATE OF INDIANA,
FLOOD CONTROL AND WATER RESOURCES COMMISSION,
Indianapolis, Ind., November 16, 1959.

Senator ROBERT S. KERR,
Chairman, Senate Select Committee on National Water Resources,
Senate Office Building, Washington, D.C.

DEAR SENATOR KERR: First, I wish to thank you for the very fine way in which the committee's hearing at Detroit October 29 was handled.

Second, you asked of me the total estimate water use in Indiana. I am sorry that I did not have the answer immediately available, as I should have had. Average daily water use in Indiana, as of 1954, was 6,871.3 million gallons. This

figure would be about 7,000 million gallons a day now. Any such figure, as you well know, is an estimate, but gives a base for forecasts of future demands.

Third, I thought you might like to have for the committee records a copy of a statement made by the Great Lakes Commission of Indiana to the full Great Lakes Commission at its November 9–10 meeting in Chicago because it touches on one of the most important problems on the Great Lakes today. It is enclosed.

Also enclosed are two copies of a summary review of progress on modernization of Indiana water laws not previously sent to your committee.

Sincerely,

ROBERT W. KELLUM,
Executive Secretary.

STATEMENT BY THE GREAT LAKES COMMISSION OF INDIANA, TO THE GREAT LAKES COMMISSION, AT ITS ANNUAL MEETING, NOVEMBER 9–10, 1959, IN CHICAGO, ILL.

Indiana endorses the statement made by Marvin Fast to the Senate Select Committee on National Water Resources, at the hearing held in Detroit, October 29, 1959, which was presided over by Senator Robert S. Kerr, of Oklahoma, and Senator Philip A. Hart, of Michigan.

We believe it is especially important to urge action on pollution surveys and control measures. In this connection, we suggest that the Great Lakes Commission gives careful consideration to seeking financial support from one of the major private foundations for a survey to be directed by the Great Lakes Commission. Also, all available data could be compiled in one place, in the commission's office, on this subject.

On the Chicago diversion case, Indiana members of the Great Lakes Commission make the following statement, as a clarification of Indiana's position as the only neutral Great Lakes State on this issue:

Recent statements by interests outside the State of Indiana have placed Indiana on one side or the other in the controversy over diversion of Lake Michigan water by the city of Chicago. Indiana is on neither side. The State has taken no position for or against the added diversion, as sought by Chicago and Illinois and opposed by the States of Minnesota, Wisconsin, Michigan, Ohio, Pennsylvania, and New York.

There is no expectation at this time that the Indiana position will be changed. The State is not a participant in the *Chicago Diversion* case.

Indiana holds to the belief that determination of the volume of flow which may be made into the sanitary and ship canal at Chicago from Lake Michigan, is an administrative problem, not a judicial problem. But, nonetheless, such problems must be solved satisfactorily in order to prevent economic stagnation of the vast industrial areas surrounding the Great Lakes.

Indiana proposes that the Congress, with the consent of the President, designate the Corps of Engineers, U.S. Army, as the agency to administer releases from the Great Lakes, any or all of them, in accordance with best engineering practices, and with approvals to be made by a special commission of United States and Canadian members annually or more frequently. U.S. members of this commission would be appointed by the President, with consent of the Senate.

A decree, handed down by the U.S. Supreme Court, lacks flexibility for adjustment to changing conditions of water levels on the Great Lakes.

When the lake levels fluctuate by as much as 4 feet, through natural causes in various years, a decree permitting a specific volume of diversion at all times, with the understanding that such diversion may affect lake levels by less than 1 inch in different locations, is impractical.

Diversion of Great Lakes waters is not a localized Chicago problem. Pumpages or withdrawals from the lakes are a matter of record in every one of the States bordering the Great Lakes, as well as in the Canadian Provinces bordering these lakes. Comparisons of changing patterns of withdrawals and inflows along the watersheds at the edges of the lakes never have been studied in detail to find all effects on lake levels. The withdrawals from the Great Lakes within watersheds whose streams flow into the lakes have been accepted on an academic rather than a functional basis. Indiana holds to the position that there are practical methods by which the lake levels of the Great Lakes may be regulated, within very reasonable limits, and that all attention should be directed toward obtaining valuable construction works of this kind—rather than to engage in disputes over any specific diversions.

It is for these reasons that Indiana avoids participation in the *Chicago Diversion* case.

The State stands ready to cooperate in providing factual assistance to the master, now appointed to the case by the U.S. Supreme Court, in whatever manner he may desire.

Until such time when the Congress may act to make changes in procedures for seeking solutions to disputes over Great Lakes diversions, Indiana recognizes, of course, the responsibilities of the master and of the Supreme Court.

(NOTE.—Participating States in the Great Lakes compact now are Minnesota, Wisconsin, Illinois, Indiana, Michigan, and Pennsylvania. All were represented at the annual meeting.)

[From the March–April 1959 issue of the Indiana State Bar Association Publication Res Gestae]

NEW INDIANA WATER RIGHTS LAW

(By Addison M. Dowling, deputy attorney general, State of Indiana, and John M. Cregor, chairman, advisory committee on water resources of the Indiana State Bar Association)

The 1959 Indiana General Assembly, by amending the Water Rights Act of 1955 (Burns 27–1401–1405), has furthered the leadership of Indiana in devising better laws to enable the people of Indiana to solve the problem presented by a constantly increasing demand for water.

The problem of providing an adequate available supply of water to meet this demand is not one reserved to future generations. It will become acute within the workspan of most of the lawyers now practicing.

In a recent U.S. Senate resolution establishing a Federal water resources study committee it was said:

"Authoritative estimates are that by 1980 the U.S. population will increase to 250 million persons, and that use of water will have increased by more than 50 percent."

The Indiana Water Resources Study Committee estimated that demand for water in this State will double by 1975, due to increased usages and population gains.

Recognizing this trend, the Indiana Flood Control and Water Resources Commission began investigations into water laws in 1952, making Indiana one of the first Midwest Eastern States to act on the problem.

The commission asked this question to stimulate study:

"With a changing pattern of water supply and water use taking shape in the Eastern United States (east of the 17 Western States known as the reclamation, or dominantly appropriation water doctrine States), should water law be modernized to meet the needs of this changing pattern?" (Irrigation began to spread in the Eastern United States as well.)

Also it asked:

"Does the long-accepted riparian doctrine (based only on prior court cases and hinged entirely to water rights of property owners of lands border or encompass surface streams) have sufficient breadth of application to assure equity in modern conditions of population growth and water use expansions?"

A third major question was:

"Is it not possible to provide substantive law by legislative action (certainly the Indiana General Assembly has power to enact law which will take the place of a common law) that may be used as a guide—and even an encouragement—toward improved water supply projects prior to actual need for such increased supply, thus eliminating many potential cases which might arise in disputes over riparian natural flow volumes?"

With these as points of attention, the commission contacted all States east of the Mississippi River, and several to the west, inquiring as to water laws within those States. It received little indication of orderly approach to law modernization. With this information, and with informal assistance of attorneys informed in this type of law, the commission proposed a new water rights law for enactment by the 1955 Indiana General Assembly.

This law, which became effective March 11, 1955, provides in section 1:

"It is hereby declared that the general welfare of the people of the State of Indiana requires that surface water resources of the State be put to beneficial uses to the fullest extent and that the use of water for nonbeneficial uses be prevented, and that the public and private funds, for promotion and expansion

of the beneficial uses of surface water resources, shall be invested to the end that the best interests and welfare of the people of the State will be served."

Further, in section 2, it was declared that the general assembly has prime responsibility over surface water as follows: "Water in any natural stream, natural lake, or other natural body of water in the State of Indiana which may be applied to any useful and beneficial purpose is hereby declared to be a natural resource and public water of the State of Indiana and subject to control and/or regulation for the public welfare as hereinafter determined by the General Assembly of the State of Indiana."

Right to flowage from public or privately financed reservoirs in natural streambeds below such reservoirs also was protected.

Domestic uses were set out as having priority at all times.

Dams across natural streams were required, to have outlets through them so that natural flow could be provided downstream and riparian rights of owners to reasonable flow, measured by best available historic records would not be damaged.

The 1955 act, likewise, established an Indiana Water Resources Study Committee for continued investigations into all problems related to modern water resources management in the public interest. Membership was provided from State units having interests, in some phase, in this resource. It included two members each from the Indiana Senate and Indiana House of Representatives: one each, either staff member or commission or board member from the Indiana Flood Control and Water Resources Commission, Public Service Commission of Indiana, Department of Conservation, State Board of Health, Indiana Stream Pollution Control Board, Indiana Department of Commerce, Agriculture, Industry, and Public Relations, and three members of the faculty staff of Purdue University.

The committee made findings and recommendations to the 1957 Indiana General Assembly, most important of which was a proposal for enactment of a new Conservancy Act. This became law and provides for special taxing districts to accomplish a number of works, such as sewer construction stream improvement, flood protection, park development, and related projects in areas where established units of government lack scope to assure most beneficial results.

Also, additions to the 1955 act were offered, but these failed of final acceptance due to technicalities in legal interpretations.

The committee continued to function on authorization from the Indiana Legislative Advisory Commission and made clarifying proposals to the 1959 general assembly for amendment to the 1955 act. These were accepted and became law March 1959. In another act, the committee itself was put on a permanent basis with responsibilities for study, but without administrative powers.

The law, as now adopted by the State, is regarded by the committee as a substantive guide to the gaining of maximum use of surface water resources in Indiana. It is a watershed maximum-use doctrine, embodying new concepts in water resources development. The committee believes it does not destroy the reasonable use rights of riparian owners but may modify them. Extent of modification, of any, remains to be determined.

The committee's views generally are as follows:

The law definitely expands potentials for stream management in the best interests of all people of the State.

It is based on the concept that the watershed, on which rain falls and over which it flows as runoff to a central drainage point, should be regarded as the basic unit on which to base engineering efforts, rather than the stream itself.

Riparian doctrine assumes peremptorily that rights to use of water from a surface stream flowing by or through properties of two or more owners are limited only to such bordering land ownerships. It ignores the fact that the main source of water in such stream is the natural rainfall on all or parts of the watershed over which the runoff from rains drains to tributary and then central streams. Thus, water flowing over nonriparian lands provides usually the largest part of volume for a stream bordered by riparian landowners. They are, in law, riparian only as they happen to be adjacent to or encompassing a stream, whereas rain-runoff supplying that stream has a watershed origin.

The watershed, therefore, is the more natural unit for establishment of modern water rights and public responsibilities of management of this natural resource.

Further, the riparian doctrine is restrictive in character. It offers little opportunity for anticipation of water shortages and correction of such shortages in the best interests of both riparian and nonriparian ownerships within a water-

shed. Management of the flow of streams by placement of manmade structures which may be operated to add to or subtract from the historic natural flow offers benefits to residents of a watershed well beyond those available merely by disputing over rights to historic natural flows without these structures in place.

The law recognizes this positive approach.

Also, surplus surface waters, which occur at irregular but frequent intervals during certain seasons of each year particularly, are treated in the new law as being available for diversion to storage off the main stream or by pumpage to other watersheds—not only to reduce flood damages but also to be made available for storage and later use in dry seasons. This may be done only if it does not interfere with established rights.

A list of definitions of a few major terms in water resources work is included in the act, as a means of providing common language for the engineering and legal professions in discussions of terms.

The right of investment is protected. If persons, organizations, or governmental units finance storage reservoir construction then the right to use of flow from such storage is protected even though the flow may be in a natural stream channel.

Mediation by the Indiana Flood Control and Water Resources Commission is authorized in case of disputes over rights to use of water in a stream. Here again a new approach toward expanded supply is made. This mediation will be provided only if petition is made for such service, to the department. Results of any mediation of this kind are not binding. Recourse to the courts is assured participants. Attempts to obtain added supplies to satisfy both parties to a dispute are authorized. Due to the changing pattern of problems related to water resources, especially in the surface branch, the committee sought this means of building up experience which would be valuable if ever a more strictly defined legal regulation of water is necessary, such as practiced in the States having the appropriation doctrine and water-use permit system. The committee felt that some States, east of the 17 Western States where water permits are required, have moved too fast from the loosely established riparian doctrine into the appropriation (or permit) system of the more arid Western States.

The new Indiana law is fashioned to the conditions of the water resources weather cycles in this region of the United States, with expansion of availability of water as a main goal.

The act establishes a priority for domestic uses of water flowing in a public water course, which uses include, but are not limited to, water for household purposes, drinking water for livestock, poultry, and domestic animals.

In summary, it would appear by virtue of the new increased and changing demands upon our water resources, there exists a policy trend, as formally declared by legislatures of Indiana and a number of other States, toward beneficial use, expansion of supplies, encouragement of seasonal storage, and restrictions upon waste and unreasonable use. It may be safely assumed that the new laws of this and other States on the subject of water conservation and use, will be subject to modification and change, as to concept and policy, so as to keep pace with the ever-changing domestic, economic, and industrial conditions in the several States of our country. At any rate, Indiana has pioneered in formulating a maximum use surface water doctrine.

The Indiana Water Resources Study Committee has had counseling from members of a number of organizations, including the Indiana Bar Association, in its deliberations.

Meanwhile, it has sponsored valuable engineering surface water invoicing, covering the entire State in units of 18 watersheds or subwatershed areas. It is continuing work on authorization by the 1959 general assembly.

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